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DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

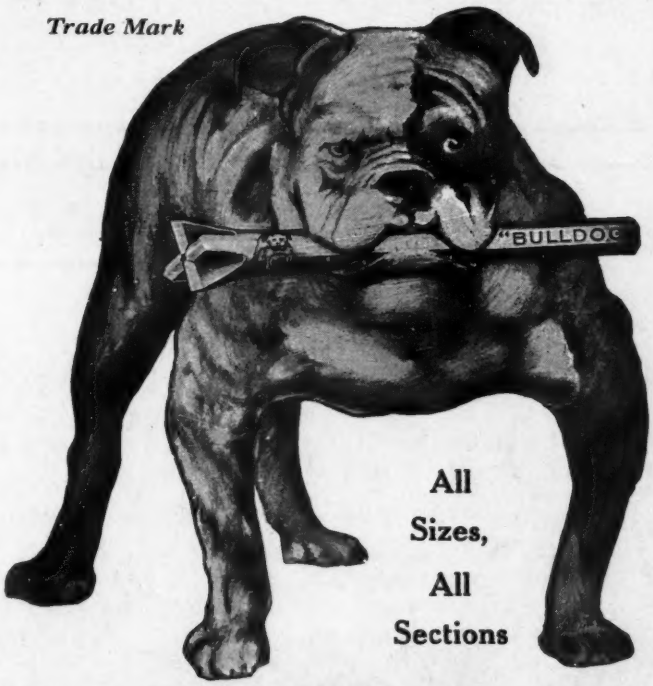
Vol. xxiv APRIL, 1919 No. 4

"BULL DOG"

MINING AND ROCK DRILL STEEL

Trade Mark

HOLLOW



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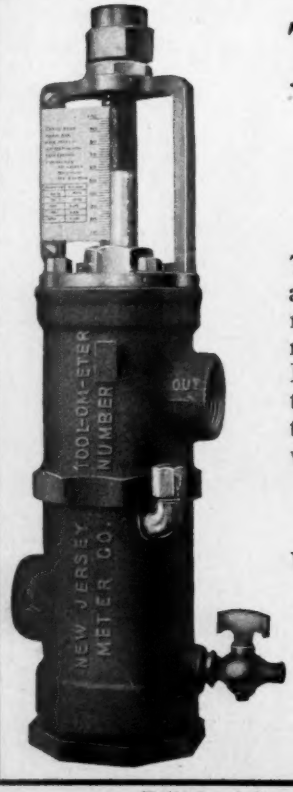

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COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Vol. xxiv APRIL, 1919 No. 4

THE BLOW OF THE DRILL BIT SHARP OR DULL.

By Frank Richards

It is sometimes greatly satisfactory to bring theory and practice in touch and to find them reciprocally confirming and strengthening each other. The method of computing the force of impact of a falling weight or of the blow struck by the ram of a steam hammer is essentially simple enough, but its practical application is generally far from satisfactory on account of the indeterminate value of one of the essential factors. We find as the final result in each case that the force of the blow struck may be almost anything, according to the suddenness with which the propelled mass is arrested. It is possible, however, without making the final particular specific, to reach a practical determination which may be most convincing.

A letter, substantially as follows, which has recently come into my hands, would seem to afford an excellent opportunity for a practical application of the principle involved in this line of investigation.

"At a drill test," the writer says, "which is being carried out at a mine near here, and in which I am particularly interested, it has been noised about that while the drill is very effective it is at the same time very hard on the steels. I was, in fact, shown some ten pieces of steel that had been broken in a day's run.

"Now, I am not a steel expert, and in this case I didn't need to be, for at a glance I noted that every piece of steel that had been broken had been used in the test entirely too long; that it had been used in fact after it had lost its cutting power. On some of the pieces the bit end was entirely flattened, no cutting edge at all was left.

"My noticing this was quite an accident on my part, but it worked out all right in the next day's drilling. Just as soon as the cuttings ceased to drop out of the hole the steel was changed and we never broke a single piece of steel. Then on one of the drills we took a dull piece of steel, and in less than two minutes' time the steel broke."

Now, if we apply the theory of the hammer blow to this case we have at once a sufficient explanation. The drill steels did precisely as they ought to have done in the circumstances. The dull steels "went on a strike" against any more striking when in that condition.

The method of computing the force of the blow of a rock drill may perhaps be more simply and clearly illustrated in the case of a reciprocating piston drill, although the results noted, under the same conditions, would be identical in the case of a hammer drill, the latter being now in actual employment more frequent and familiar.

The unit generally assumed in stating or in computing the force of a blow is the foot-pound. Say that we have a rock drill with a piston 3 in. in diameter and a stroke of 6 in. (½ foot), and that in the working stroke of the piston it is driven the entire distance by an effective air pressure of 50 lbs. per sq. in. The area of the piston is almost exactly 7 sq. in., and if the strokes of the piston were 1 ft. the accumulated force at the end of the stroke would be stated as: 7x50x1= 350 foot pounds. Since the assumed stroke of our piston is ½ ft. the resulting force

would be only one-half of this, or: 7x50x½= 175 foot pounds.

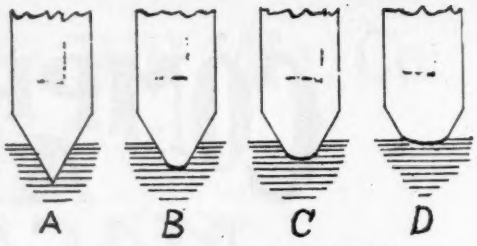
This number of foot pounds of energy might have resulted from various combinations of stroke and pressure, as, for instance, with a stroke of 1 ft. and a pressure of 25 lbs.: 7x25x1=175 foot pounds, or with a stroke of 3 inches, (¼ ft.) and a pressure of 100 lbs.: 7x100x¼=175 foot pounds. It is essential to get this clear in our minds because in bringing the piston to rest, or in the striking of the blow, an opposing force of resistance is required precisely equal to the active force that was employed to produce the motion.

The resistance will of course be required to be greater in proportion as the distance in which the resistance is applied is shorter. Thus 50 lbs. of resistance effective through 6 in. of stroke would be required to overcome the 175 foot pounds of imparted energy, and 6 times this, or 1050 lb., would be required if the stoppage was done in a distance of 1 in. For convenience we may call this last figure 1000 lb.; then 4000 lb. of resistance would be required to stop the movement in ¼ in., and 16000 lb., 8 tons, if the stoppage was done in 1-16 in.

This brings us to what we may assume to be, approximately, rock drill cutting conditions. If the drill bit penetrates the rock, say, 1-16 in. at each blow then this 8 tons is applied, and alternately is stopped entirely, several hundred times a minute, and while our theorizing here requires a constant or mean resistance of 8 tons for the entire 1-16 in. of penetration of the rock, the fact undoubtedly must be that the resistance will be much greater than this at the beginning of the penetration and diminish to nothing at the instant the penetration ceases. If the penetration of the drill bit was only one-half of this, of 1-32 in., that is if the bit was stopped within this distance, then the force of the blow struck by the bit would be double the above or 16 tons.

When we say that the bit strikes the rock with such a force it would be just as correct to say that the rock strikes the bit with this force, for it must be precisely equal in each direction from the point of contact, and the greater the force at any instant with which the bit strikes the rock the greater also must be the reacting force against the body of the bit.

The rough sketch herewith, representing



WEAR REDUCES PENETRATION

with perhaps some exaggeration, one of the four wings of a sharp drill bit, and then the same in several stages of wear, may help us to get a clearer understanding of the matter. At A, with bit perfectly sharp, we see that it makes its deepest penetration into the rock. After coming in contact with the rock surface it penetrates the rock a certain distance, during which penetration its force is expended upon the rock in one direction and equally backward into the body of the bit in the other direction.

It is assumed here of course that the drill bit receives at each stroke an equal impulse from the air which drives the drill. We note at B that the bit has been considerably worn or blunted, and that while when it first touches the rock it has the same force behind it which it had at A, it does not penetrate the rock to the same depth, it is stopped within a shorter period of travel, and consequently the force involved in the stoppage must be greater for the shorter period, both upon the rock and back into the drill bit.

No computations could help us to realize the evident fact that the force of the blow upon the rock, and reactively back into the body of the steel, is successively greater when the bit is worn as seen at C and D. At D the penetration of the rock must be extremely minute and the shock upon the drill bit incalculably great. What could be expected of the steel under such conditions, or approaching such conditions, than that it should give up the job and break? The fact of breakage when the bits are too much worn is an endorsement of the efficiency of the drill which applies the power, and demands for the drill appreciation instead of condemnation. A drill which does not break its bits when, on account of dullness, they ought to break, must be defective in some particular.

It will be noted from the preceding that in the action of the drill bit when it wears a

paradox occurs. The bit is least effective, has the least penetrative result, blow for blow, when it strikes the rock the hardest and feels the shock the most. It is the sharp bit that does the work; the dull bit is the inefficient victim of mistaken or neglectful practice. Drills must wear, but the limit of permitted wear should be sharply prescribed, and the systematic maintenance of sharp bits should be recognized as the most profitable investment possible in connection with rock cutting operations. Especially is the power drill-sharpener to be commended, not only for its almost incomparably greater efficiency as compared with hand sharpening, but also for its promotion and maintenance of the sharp drill habit of thought and practice.—*Eng. and Min. Journal.*

COMPOUND AIR LIFT FOR MINE WATER

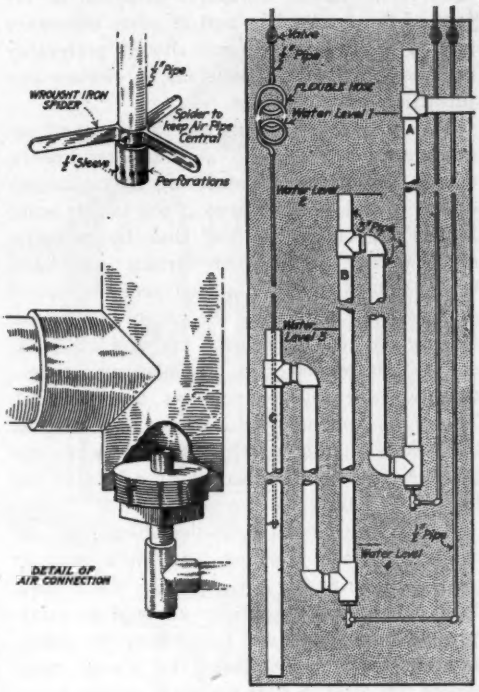
By A. W. Allen

The compound air lift is suitable where objections may be raised against the construction of a sump of sufficient depth to satisfy the efficiency requirements of an ordinary single lift. It is also applicable when the available pressure of air is low. The depth of the various stages can be adjusted in this particular, but it must be remembered that a very low available pressure is likely to cause unnecessary complications in the arrangement by introducing too many units. This necessitates a proportionally large number of pipe fittings, and increases friction. Under such conditions the system is not recommended, although exceptional cases may call for exceptional methods of treatment.

THE FUNDAMENTALS OF A COMPOUND AIR LIFT

A compound air lift is merely two or more simple air lifts arranged in series—the rising main of the first discharging into the sump of the second, and so on. A loss of fall at each stage is inevitable, and this also involves a small loss of power. The system can be arranged to duplicate or triplicate any of the ordinary designs in use; and the customary self-regulating features can be incorporated in each of the various units.

I once had occasion to utilize the compound air-lift principle under somewhat unusual circumstances. An old mine working had to be dewatered to drain an adjoining shaft. The ground was loose on all sides, the timbers



COMPOUND AIR LIFT

were in a rotten and collapsing condition, and ancient-filled stopes would "run," and discharge debris at the least provocation. The old working had to be drained as far as possible by a system that made personal attention near the water level unnecessary.

A small compressor furnished air at a low pressure; and, even if a pump could have been made to do the work, there would continually have been the danger of interment of both the pump and anyone who happened to be attending to it. A compound air lift was therefore constructed which permitted the gradual lowering of the water to a level in proportion to the depth of successive submergences, and so personal risk was eliminated. Soundings disclosed the fact that timbers had collapsed to such an extent that only a narrow channel remained in one place. This was found sufficient, however, to permit the passage of the lift pipes.

A somewhat diagrammatic drawing of a compound lift of this class is shown in the illustration, but in actual construction it is, of course, possible to bunch the various pipes together, and so insure greater compactness

than is indicated. Strainers attached to the foot of the lowest lift, and at other necessary points, are advisable, and should preferably be made of ample dimensions to obviate any throttling of the intake.

The need for the constant shifting and readjustment of the pump, as the water lowers, can be avoided by constructing the apparatus complete and by placing it at the lowest point in the first instance; and then by pumping the water in stages, the various pipes can be assembled, and the added sections bolted or screwed together as the pump is lowered. Permanent air connections are indicated, but can be omitted when it is considered preferable, and flexible connections used instead. The permanent connections were available, in the instance under description, only when the pressure had been reduced by the help of the flexibly connected air pipe.

It will be noticed that the permanent air connections are attached through a plug at the lower arm of a T-piece in each case. This design was purposely adopted to minimize friction, as it was found that the extension of the air pipe into the rising main served no useful purpose and, furthermore, constricted the suction of the pump. By arranging the supply as shown it was found that there was no tendency for the air to escape other than where it was needed, except when an unnecessary volume was being used.

There is one disadvantage in the use of the flexible air connections and a loose pipe system, apart from the fact that the introduction of another pipe in the rising main increases the frictional resistance, and that is due to the fact that the air pipe may rest against the side of the lift pipe. This will result in a partial distribution of the air through the liquid. The objection may be of little account in the case of small lifts, but should be avoided in large ones. The ill-effects may be reduced by bolting a "spider," of three arms, to the outside of the air pipe, near the bottom, which will maintain it in a central position (see cut). The arms must be of such a length that the "spider" forms a *very* loose fit in the inside of the rising main. It is preferably made of wrought iron, and kept from slipping off at the bottom of the pipe by means of a sleeve which may be bored around its lower end, in the manner shown, in order to distribute the air more effectively.

OPERATION OF COMPOUND LIFT WITH FLEXIBLE AIR CONNECTIONS

By reference to the diagram it will be noticed that four water levels are given. It may be assumed that level No. 1 shows the original position of the water. The flexible air connection is then put into the rising main *A* to a depth consistent with available pressure, and gradually lowered therein as the water is reduced in the shaft until level No. 2 is reached. The flexibly connected pipe is then withdrawn from rising main *A* and transferred to *B*. As soon as the second lift is in operation, water will be delivered so that lift *A* can be operated by means of the permanently connected air pipe. As soon as water level No. 3 has been reached, the flexible connection is withdrawn from air lift *B* and transferred to *C*. As soon as this is in operation, the permanent connection to supply air for lift *B* can be used. The final water level will be approximately as shown at No. 4, with the air pipe at the bottom of the lowest lift pipe.

Ratio of submergence to lift will vary in such installations according to local conditions. Economy in small lifts may demand a ratio of from 1½ or 2 to 1 of submergence as compared with lift. In other instances economical work is of secondary consideration, especially where air pressure is low, and a shallow submergence may be adopted.

The arrangement shown permits the easy escape of the air when lifting is accomplished. Spasmodic or jerky delivery of water usually indicates faulty conditions as to air volume or submergence ratio, which should be regulated as far as practicable to insure a more or less even stream from the discharge pipe.—*Eng. and Min. Journal.*

NOVEL IDEA FOR A STEAM ENGINE

The following is one of the claims of a recent U. S. patent:

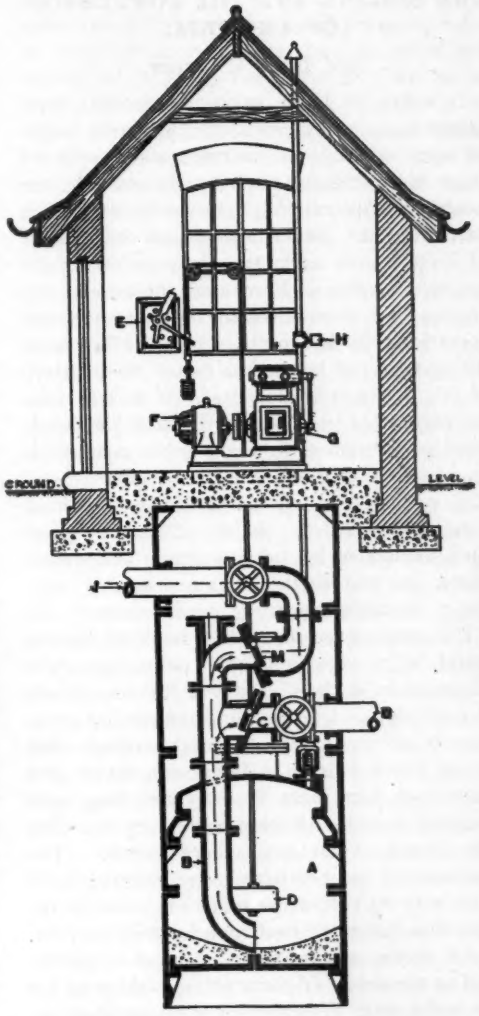
"In a device of the class described, the combination of a cylinder, a piston reciprocally mounted with said cylinder, means for electrically heating said piston, and means for injecting a spray of water onto said piston thus creating steam within said cylinder for driving said piston."

AN AUTOMATIC AIR PRESSURE SEWAGE EJECTOR

The device brought to the notice of our readers in the abbreviated description and accompanying sketch here reproduced from *Iron and Coal Trades Review,* London, may be regarded as a curiosity rather than as of practical value. The arrangement has an ancient rather than an up-to-date suggestion, the best thing to be said about it being apparently that it will actually work when everything is all right, but the mode of using the compressed air, and the actual wastage of compressed air for filling spaces seriously detract from the practical efficiency.

The device, which is put before the public as a business proposition, is designed to popularize the direct system of pumping water, mud, sand, sludge, silt, gravel, sedimentary deposits, sewage, etc., by compressed air. The apparatus consists of a pneumatic ejector, an electric motor, a float-switch, and an air compressor. The arrangement is shown in the diagram. In operation, the sewage flows by gravity into the ejector body A through the inlet pipe B, passing the flap valve C, and rises in the ejector A. A float D is placed in the ejector and connected to the switch E, and as the sewage rises and falls in the ejector, the float moves up and down; this movement operates the switch E, thus making or breaking the circuit of the motor F driving the air compressor G. For instance, when the sewage attains a pre-determined level in the ejector, the switch contacts are closed by the float, thus starting the motor and compressor, and when the level of the sewage falls to the required degree, the float opens the switch contacts and stops the motor.

On the air pipe connecting the compressor to the ejector, there is a magnetically-operated valve H controlled by the float-switch. When the motor is started this valve is closed to the atmosphere, and when the motor stops it is opened. This action is brought about by means of the float-switch opening and closing the circuit to a solenoid which operate the valve. As soon as the compressor starts working it pumps compressed air on to the surface of the sewage in the ejector. The pressure so applied closes the inlet valve C, and drives the sewage from the ejector A, past the outlet flap valve M into the outlet



AIR PRESSURE SEWAGE EJECTOR

pipe J, and thence into the rising main, through which it is forced to the desired outfall. The ejector continues to discharge until the float opens the switch contacts. This action stops the motor and opens the exhaust valve H. In this way the compressed air left in the ejector is allowed to exhaust to atmosphere. As the air pressure is being exhausted, the weight of sewage in the rising main closes the outlet flap valve M, when the ejector begins to refill. This cycle of operations is repeated automatically so long as any sewage flows from the sewers.

THE BOILING AND THE CONDENSING OF AMMONIA.

By John E. Starr

It seems to be in many minds that their ammonia or other liquid "flashes' into a gas in some mysterious manner when relieved from high pressure and introduced into the lower pressure existing between the expansion valve and the commencement of the process of liquefaction, as in the compression or absorption machine. Erroneous theories of operation are then founded on this supposed operation. If the operator keeps in his mind the analogy of his steam boiler the mystery of this action will disappear. If he will simply regard his expansion piping and his "accumulator" system as he regards his steam boiler, and treat it in the same way, all his troubles will be cleared up. If he will further keep in his mind the subject of absolute pressure, unclouded by the pressure of the atmosphere, he will further attain wisdom.

STARTING POINT OF STEAM GAGE

His steam gage through a freak of custom starts at a very indefinite point, generally supposed to be the pressure of the atmosphere at sea level, and to his mind the zero of pressure is about 14.7 lbs above the actual zero. Points below this he calls vacuum, when as a matter of fact there is no such thing, and vacuum should only mean a pressure less than the weight of the atmosphere exerts. The anomaly of the pressure gauge starting as it does with its zero at an indefinite point, is responsible for much confusion in point of view.

All matter commonly exists and is exhibited to the senses in three states,—solid, as ice the solid state of water, or common iron the solid state of iron, or liquid as the liquid state of water or molten state of iron, or as a gas, —as steam, the gas of water, or iron fumes, the gaseous state of iron, all depending on the pressure and temperature under which they exist, and pressure and temperature must never be disassociated.

PASSING FROM LIQUID TO GASEOUS STATE

Water boils or passes from a liquid state to a gaseous state just as surely under a pressure of 1 lb, per square inch and a temperature of 101.76 F. as it does under a pressure of 14.697 lbs, per square inch and a temperature of 212 F. If it has a pressure of 25 lbs. it will have to be kept heated to 240.1 F. to cause it to pass from a liquid to a gas (steam).

In a like manner if liquid ammonia is held under a pressure of 1 lb., it will pass to a gas if heat at 103.7 deg. F. is constantly supplied to it, or if a pressure of 14.76 lbs. is applied it will "boil" or pass to a gas at 27 below zero; while if a pressure of 25 lbs. be maintained it will pass to a gas if a constant temperature of 7.2 below zero F. is supplied, or if it is kept at 30 lbs. (or about 15 gage) it passes to a gas at about zero F.

Now to oblige a liquid to pass into a gaseous condition heat must be applied to the liquid. Take a familiar experiment. Draw off a half glass of anhydrous ammonia; after a moment plunge a thermometer into it, when the bulb of thermometer is covered with the liquid it will register about 27 below zero if the atmosphere happens to have a pressure of 14.76 lbs. If the atmosphere happens to have a pressure of less than 14.76 lbs., say 13.75 lbs. (corresponding to 28 ins. mercury) the thermometer will show between —29 and —30 F.

Add heat to the liquid by immersing the glass in water say at 80 F. but keep the pressure the same. The liquid will boil more violently but the thermometer will not budge because the gas is constantly passing away into the air at the above pressures. Take out the thermometer quickly with a thin film of liquid adhering to the glass and the mercury sinks; but this is another story.

Observe, however, that the frost line is only slightly above the level of the liquid, because you have already put your heat with the liquid and the gas while in its expanded condition it has but little capability for taking up heat and therefore is rapidly warmed up. This at once teaches that little heat is taken up by the gas and that refrigeration is produced, or heat is taken away in a large part, only where it touches or adjoins the liquid and that the gas takes little heat.

It is true that your suction pipe may be frosted clear into your compressor or absorber, but this is only because the gas is solid and takes up some heat or because liquid is present, foaming or projecting mechanically from your "boiler" or expansion piping.

So if you are cooling a liquid (say beer) by direct expansion, and observe that the cooler is "frosted out" don't be sure that it is at full capacity; for the last pipes may be full

of a volume of gas and not liquid, and the capacity of gas to take up heat is small and your "tonange per foot" of frosted pipe may be small. Increase your feed of liquid and your tonnage per foot will increase, although to be sure you may run the physical risk of "flooding" your compressor.

Now apply the same line of reasoning that you apply your steam boiler. You would be foolish if you wanted to generate steam, to apply your fire or your heat to the steam space instead of the water. You would be equally foolish to expect to receive heat from the steam line unless steam was constantly supplied to it and was giving out heat in passing back from a gas to a liquid. Nor would you close up the surface from which the steam emerges from the water. You would not fill the boiler chock full of water or take off the drums from your water tubes. You would leave a certain amount of free surface in your boiler or "boiler level" between the water and the steam in order that the bubbles of steam that are formed all through the boiler could have ample room to break through the water surface without dragging water with it and making "wet steam."

So with ammonia, you either provide enough pipe so that the liquid will all be boiled into a gas, even admitting the gas "spits" the liquid a little ahead until it loses it, or you will fill the pipes with liquid and outlet them into an "accumulator" where the gas bubbles have a chance to leave a large surface of liquid without lifting it up and dragging some of it along mechanically, in to the final suction of pipe.

THE DROP OF THE LIQUID PRESSURE

What happens when a liquid under pressure on the high side of the expansion valve passes to a tower pressure on the other side? In the first place the liquid has been cooled to a comparatively high temperature, say 80 F. After it passes the expansion valve it must be cooled first to the comparatively low temperature of its boiling point on the low sides. Say the back pressure is 30 lb. (15-gage); then the boiling point is about zero F. Enough of the liquid must pass from a liquid to a gaseous state to cool the balance from 80 to zero. To do this it takes heat from itself, and enough liquid boils to a gas to reduce the balance to zero F. A pound of liquid passing to a gas will, under the circumstances stated as to temperature and pressure, take up 572-1 B. t. u. But it has to evaporate enough of itself to reduce itself from 80 to zero. This amounts to about 87.3 B. t. u. Hence about 17.5 per cent. of ammonia liquid has to evaporate to lower 1 lb. of it from 80 to zero, leaving 572.1—87.3=484.8 to be supplied by the brim or air to be cooled. This is called the taking out of the "heat of the liquid."

If the air or brim is above zero it will add this heat in time. If it is 10 or 15 above zero it will add heat faster but, as we have seen, it will add it at the same temperature to wit, zero if the pressure of 30 lb. is held constant. The gas resulting from this boiling passes along mixed with the liquid, and finally escapes to the compressor or absorber. As the liquid rolls along it also gradually takes up the 484.8 B. t. u., and the whole mass rolls along until the liquid is all spent or until it reaches the accumulator where the gas separates from the surface of the liquid and goes to the compressor or absorber.

The combined gas and liquid "rolls" along, even "up hill," in the narrow pipe because it is pushed along by the accumulating gas and will continue to roll along, and the liquid will take up heat until it has all passed to a gas and only gas will continue because that gas must go on to fill up the space constantly made vacant by the compressor or absorber. But only where the liquid touches is there any amount of heat taken up.

Towards the end of a direct expansion pipe leading direct to the suction pipe not so much heat per square foot of pipe is taken up because there is not so large a proportion of liquid, it becomes more and more mixed with gas.

An accumulator is placed at the end of the piping system in order to keep the pipes as full of liquid as possible and this accumulator should have "disengaging surface" sufficient to allow the bubbles of gas that come along with the liquid to break through without lifting the liquid and carrying some of it along with it to the compressor or absorber.

If "wet compression" is desired, it is probably better to introduce a definite amount of liquid ammonia by an expansion valve at the compressor, and to boil all of the liquid out in the evaporator, than to rely on the rather haphazard projection from the evaporator.

In a gravity system of evaporation, it is quite possible and theoretically good practice to place a vessel similar to an accumulator at the beginning of the pipe system, and rid the gas generated in cooling the heat of liquid from the cooling coils, by passing it to the gas suction direct.

Regard your expansion system as you would regard your water tube boiler and keep the analogy constantly in mind and you cannot go astray.—*Refrigerating World.*

PAPER MATERIAL MAKES GOOD PIPING

Americans are showing interest in a German war product, "pertinax," a compressed paper material, which appears to have had a double usage: as a substitute for iron, lead and copper pipes; and as a substitute for porcelain or mica for insulators. The pipes are made by impregnating sheets of paper with synthetic resin, and rolling them around a mandrel of the desired dimensions until the proper thickness is secured. Heat and pressure are maintained meanwhile until a hard product is obtained. Formerly natural resins were used, but the introduction of the synthetic variety has raised the temperature of softening to above 180 deg. C. (356 F.)

Difference of opinion seems to exist as to the effects of water upon the material. Though one writer claims that it is insoluble and waterproof, another states: "Their absorption of water makes their use inadvisable for that liquid, but they gave excellent results when used to carry oil, a fact which is explained by the well-known resistance of synthetic resins to oils." There is no record of their being used successfully for water pipes, though they were practical for carrying gas and oil.

Experiments showed that pertinax pipes could bear interior pressure three to four times as great as that of lead pipes, while the weight is less than a ninth that of lead. A series of tests made at the Royal Institute for Testing Materials showed that they are not fitted for construction uses, since, while their resistance to tension is sufficient, their resistance to compression and their elasticity are both too feeble. The tensile strength is 14,250 lb. per sq. in. The stuff may be worked similarly to wood, being turned, stamped, sawed out and bored.

A HYGIENIC SAND BLAST ROOM

The outline sketch shows a complete sand blast room with appurtenances and connections built by the Pangborn Corporation, Hagerstown, Md.

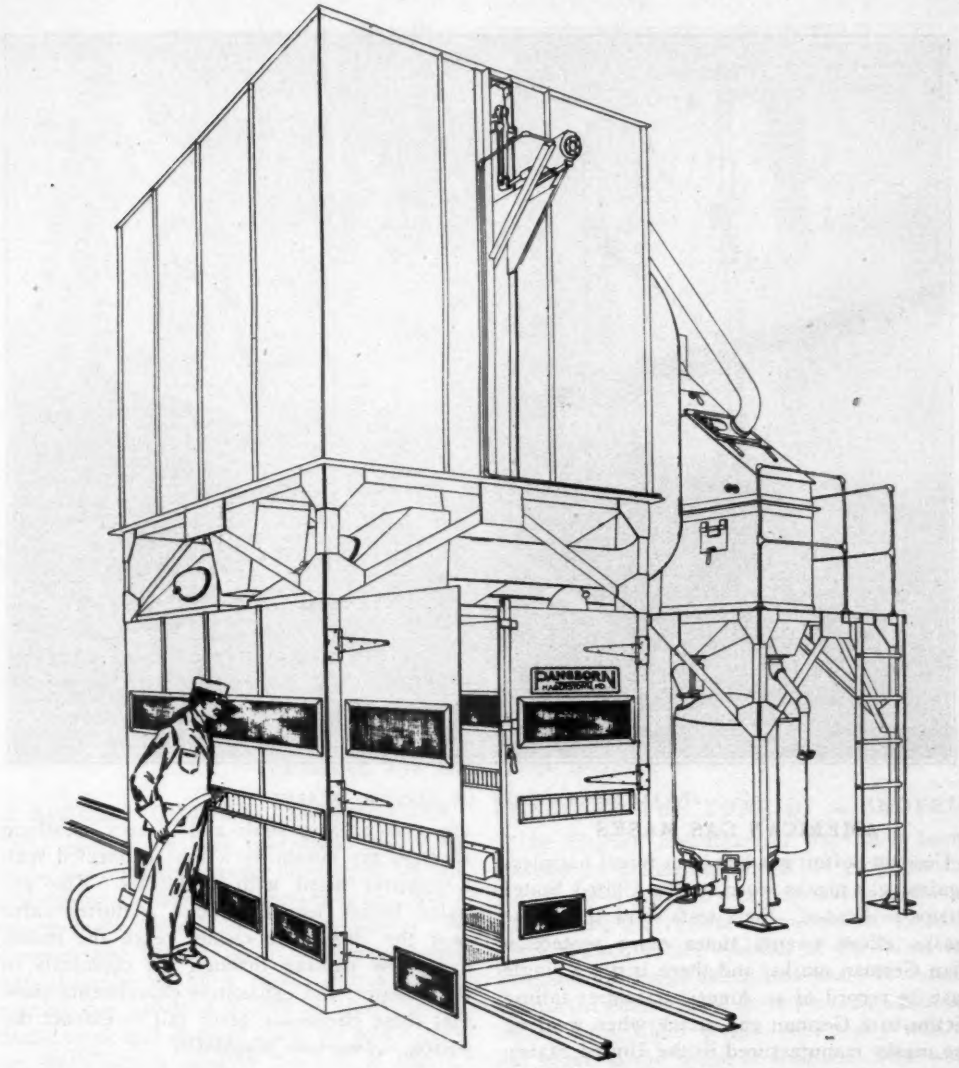
This type of installation is designed for the handling of large work and to provide means of operation that render unnecessary the presence of the operator in the room where the sand blast operation takes place.

The room as here shown is constructed of 3-16 in. steel plate supported by reinforced steel structure. Around the four sides of the room at convenient height is a nozzle slot closed by multiple, sectional, flexible curtains, through which the nozzle is inserted and allowed freedom of movement in all directions. Above the nozzle slot at eye height is a sight screen, fully protected by specially woven heavy wire cloth, which prevents escape of flying abrasive and permits unobstructed view of the interior of the room and the work.

The sand blast machine, which is of the direct high pressure type is located outside the room with hose of sufficient length to permit the operator to reach every portion of the structure. The room is equipped with a grated floor through which the spent abrasive, core sand, refuse, etc., pass to the conveyor trough where a sectional type screw conveyor delivers it to an elevator boot, the entire material being raised to a combined mechanical screen and exhaust separator where the fine dust, core sand and refuse material are separated and passed to a refuse bin piped for discharge to a convenient point. The clean sharp abrasive for re-use is delivered to a storage bin connected to the sand blast machine by a filling valve, for automatically refilling the machine.

Electric light fixtures with white porcelain enameled reflectors and fitted with discoloid fronts to protect the lamps from flying abrasive, are placed as required for ample illumination throughout the entire room.

The dust generated by the blasting operation is drawn off through a ceiling hood and passed to a dust arrester. This arrester, of the cloth screen type, is mounted above the room and supported by the structural frame. The dust laden air enters at one side, the air passing through a multiplicity of cloth screens which retain the dust, delivering it to hoppers



HYGIENIC SAND BLAST ROOM

which can be piped for discharge as convenient.

Air inlet screens to permit free ingress of ample fresh air are placed around the base of the room. A heavy, close woven-wire screen cloth on the outside entrance prevents entrance of foreign material, while on the inside a hooded baffle prevents escape of flying abrasive and dust, and without retarding entrance of the air. The room can be equipped with industrial track to pass through swinging doors at either end for routing of the material as desired.

This type of room is particularly advantageous in the handling of large heavily cored work and is made to conform in size and shape as nearly as is practicable to the work, so that ventilation requirements may be kept at a minimum. For the cleaning of long pieces such as lathe beds, etc., these are usually handled one-half within the room, the entrance being protected by flexible curtains through which half of the casting projects, the piece being turned to clean the other end. In this way pieces up to 20 and 30 ft. long may be handled in a room but half the length

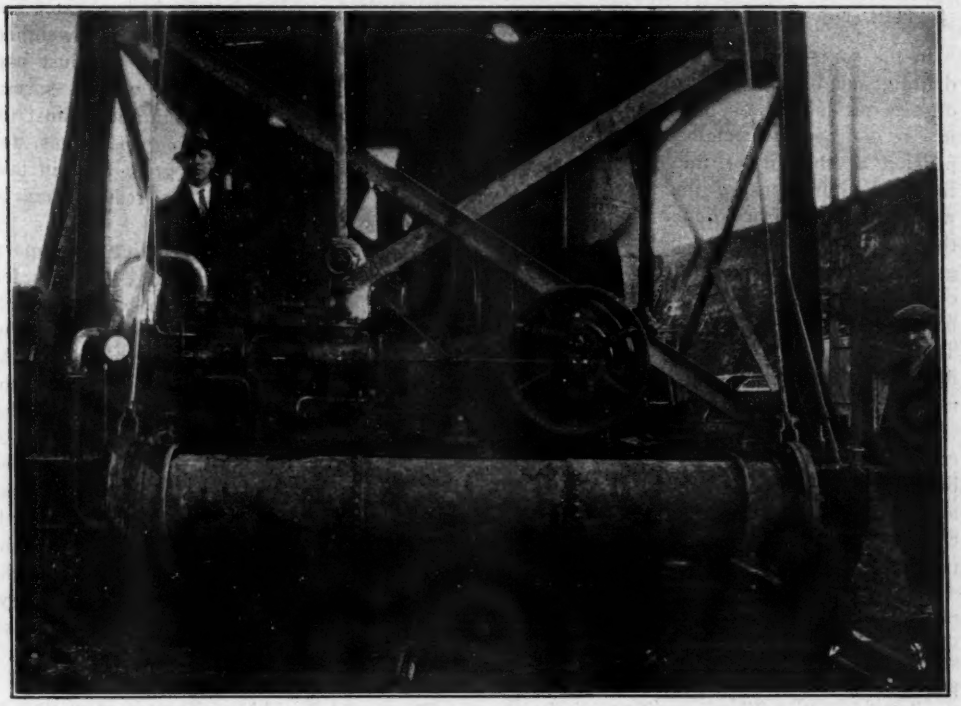
SPECIAL TRANSPORTER IN GYPSUM QUARRY

AMERICAN GAS MASKS

German poison gas has been found harmless against gas masks worn by the United States troops in France. Field tests show that these masks afford twenty times more protection than German masks, and there is not a single case on record of an American soldier falling victim to a German gas attack when wearing the masks manufactured in the United States. This fact has been so thoroughly established by repeated experiences that military authorities place the blame for gas poisoning on the carelessness of the victim. Many American Army officers believe that in most cases the men who get gassed should be courtmartialed, not decorated. Every American soldier who goes to France is a gas-mask expert. He has been trained to adjust his "land life preserver" with almost incredible speed. The mask is put on with five motions of the arm and hands. Although a gas mask is a very uncomfortable article to wear the first few times, the soldier soon becomes accustomed to this handicap on the natural way of breathing. It fits over the head like a baseball catcher's mask. A nose clip closes the nostrils and insures breathing through the mouth by a tube connected with a canister filled with chemicals. The exhaled breath leaves through a flutter valve near the chin. Air cannot reach the mouth except by passing through the chemicals in the canister, and exhaustive experiments show that these chemicals never fail to extract the poison.—*American Machinist.*

INDUSTRIAL GAS MASKS

The Bureau of Mines announces that it is making a preliminary investigation of gas masks with a view to establishing a list of approved devices for use in the mining and allied industries. After the preliminary investigation the Bureau will issue a schedule of tests which apparatus must meet in order to gain the approval of the Bureau of Mines. These investigations will be conducted at the Bureau's Pittsburgh station by men who have had intimate connection with the development of mine rescue apparatus and gas masks used in warfare.



COMPRESSOR AND RECEIVER ON TRANSPORTER

A SPECIAL QUARRY TRANSPORTER

The two photos here reproduced tell most of the story of a transporter doing good service in the gypsun quarry of Cafferata & Co., Newark-on-Trent, England. The material is loosened and broken up by jackhamers and then is delivered by a steam shovel into a tracting car which is hauled up the long inclined track and dumped upon the pile a portion of which is seen at the left of Fig. 1. The width of the track upon which the transporter stands gives it the required stability with the traveling car at either end.

On the platform of the transporter are a steam boiler and engine for driving the drum which carries the wire rope for hauling the car back and forth. There is also an Ingersoll-Rand compressor, F R-1, which supplies air at a constant pressure of 80 lb. for operating the jackhamers. The air receiver, it will be noticed, is somewhat unusual, being made of 16 in. wrought pipe suspended immediately in front of everything by a rod at each end, with also a clamping loop at each end holding it horizontally.

CHANGING THE TONE OF A SHOVEL

The English manufacturer has often been accused of failing to adapt his products to the needs of foreign markets, but a striking instance of the reverse is mentioned by Mr. Cecil Walton in the *Journal* of the West of Scotland Iron and Steel Institute. In South Africa the Kaffirs used an implement which is known as a Kaffir pick, which really was a flat spade in the shape of a heart. This was used as an axe, as a pick, and as a spade. A sample of it was brought home to this country and reproduced here. Mr. Walton said that he would have defied any man to detect the difference between the English and the native article. But still they could not sell it, so a representative went out from home and right up country. He found there was one thing that the Kaffir used the pick for of which they knew nothing. That was, he took it out of its haft and used it as a cattle call, and they found they had not quite the right note. Having discovered this, they reproduced the Kaffir pick with the right note and established an enormous trade in it.

SAMPLING OF DUST IN MINE AIR*.

In the course of such mining operations as drilling and blasting, a large amount of fine dust is produced, and, being infinitely small in size and of little weight, it remains in suspension in the air of the mine for a long time. Examinations of the lungs of miners who have died from miners' phthisis show that the lung tissue has been converted, to greater or less degree, into a mass of siliceous tissue, in which is imbedded a large number of small, sharp, angular pieces of quartz. This condition is due to the constant breathing of the fine particles of dust present in the mine air.

Nature has provided means of rejecting a certain amount of the dust present in the air breathed, but when the quantity is so large and the particles are so small as in mine air, the natural filter becomes choked and allows the dust to enter the lungs.

PRECAUTIONS TO REDUCE DUST IN MINE AIR

The use of water to allay the dust produced in mining operations reduces the danger to a great extent. Directing a spray on the hole in all drilling operations with machines; insisting on all hammer boys using water, even in collaring a hole, and on the use of a wet swab when the hole has been started; sprays in drives, water blasts at blasting time, and other precautions effectively carried out have so reduced the amount of dust in suspension in the air that the danger of contracting silicosis, or miners' phthisis, is being materially lessened.

PERIODICAL SAMPLING DETERMINES EFFECTIVENESS OF PRECAUTIONS

To assure precautions to keep down the dust and to prevent carelessness in regard to the use of dust-allaying appliances, a system of sampling the mine air for dust has been adopted, and periodical tests are made throughout each mine to see that dust is being allayed to the lowest possible amount. The method consists of passing a known quantity of air through a known weight of pure sugar. The sugar, dampened with the moisture present in the mine air, becomes sticky and catches all of the dust in the air passed through it. The sugar is then dissolved in hot water and the residue of dust filtered off and weighed. Because of the minute size of the dust particles and also of their light weight, special precautions against contamination must be observed in all dust-sampling operations, and it is necessary to exercise great care in taking the samples so that the results may be dependable.

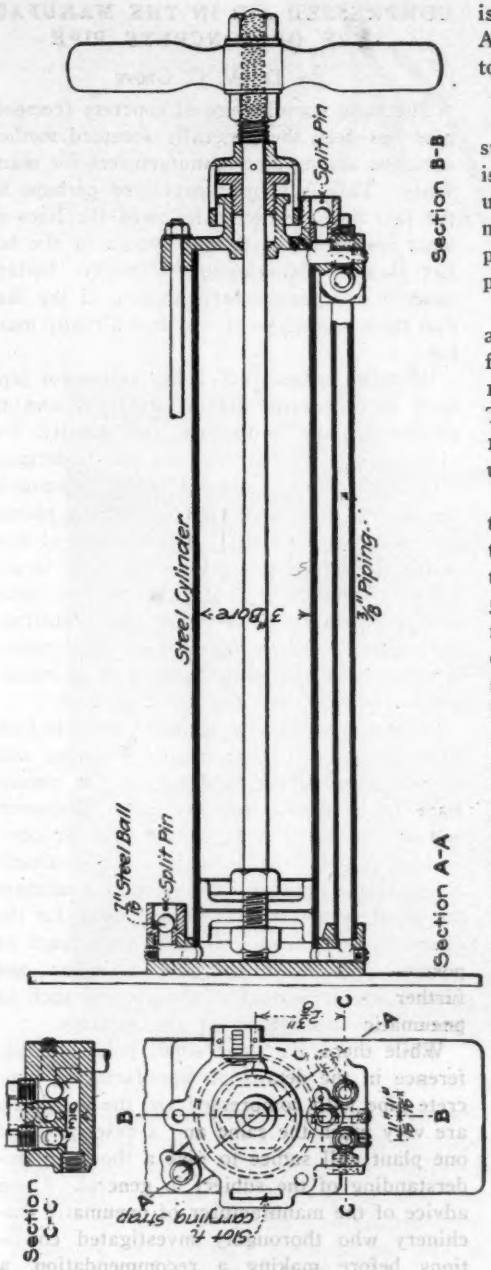
An air suction pump consisting of a metal cylinder 22 in. high and of 3-in. diameter, double acting and fitted with ball valves, is the principal part of the sampling apparatus and is shown in an accompanying cut. The pump requires constant attention, and the piston rod and ball valves should be oiled daily before being taken underground. A small quantity of medium oil should be poured into the inlet tube, and several strokes of the pump taken to introduce the oil into the cylinder. The gasket and nut at the top of the piston should be screwed down tight, and the pump tested by closing the inlet pipe and trying to pull out the piston. If the pump leaks, the piston will come up easily, which it should not do.

The pump should be calibrated from time to time, and at least once a month against the standard air meter in the Chamber of Mines laboratory. This will give the number of strokes required to aspirate the required quantity of air.

The sugar containers for collecting the dust are simple in construction, consisting of a glass tube (5 in.x1¼ in.) fitted at the top with a solid rubber cork and at the bottom with a rubber cork through which passes a piece of glass tubing. On top of the latter cork is placed a small pad of cotton wool, which prevents the sugar from being sucked down the tube into the pump. Forty grains of coffee crystal sugar, ground to pass a 10-mesh and remain on a 20-mesh sieve, are placed in the tube and the solid rubber cork is fitted into the top of the tube.

A 6 ft. length of ½ in. rubber tubing is used as the connection between the sugar tube and the pump. One end of the rubber tube is attached to the inlet pipe in the pump and the other to the ½ in. glass tube which projects from the bottom of the sugar tube. It is necessary that the rubber connection be examined frequently to see that there are no leaks, and care must be taken that it is prop-

*From report of J. Boyd, chief sampler, Transvaal Chamber of Mines, Johannesburg.



PUMP FOR DUST SAMPLING

erly fastened to the pump and to the sugar tube.

The sugar tubes should be carried in a wooden box, lined with felt, of a size convenient for underground tests. A useful box is one 19 in. long., 11 in. wide and 3 in. deep. A thermometer should be carrled in the box, together with a small note book.

MANNER OF PROCURING THE DUST SAMPLE

Having tested the pump, see that a full stroke is taken each time that the pumping is done. This must be done at a slow, regular rate—10 strokes per minute being the maximum—as the successful working of the pump depends on a slow, regular rate of pumping.

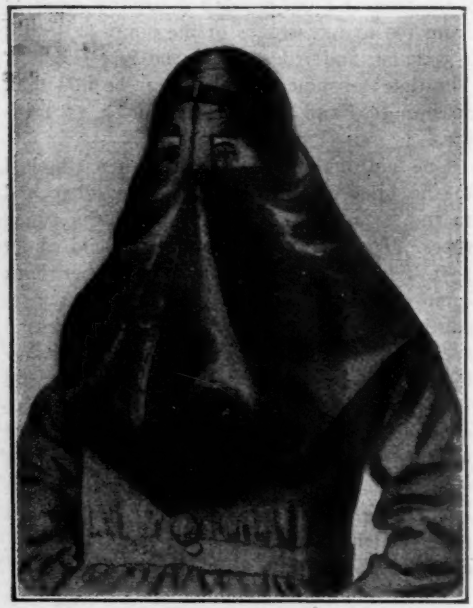
The quantity of air to be tested should be a fraction of 1 cu. m., and it usually requires from 100 to 120 strokes of the pump to secure 1-3 cu. m. and from 150 to 200 for ½ cu. m. The time consumed should never be less than 10 minutes, and usually should be 15 minutes.

One end of the rubber tube is then attached to the inlet of the pump and the other end to the ½ in. glass tube of one of the sugar tubes. The sugar tube should be held about 5 ft. from the ground and the rubber cork removed from the top of the tube. As a precautionary measure, care should be taken to see that the sugar tube is not under wet hanging, so that drops of dirty water or material fall into it. It is well to remember the small quantity of dust that is to be collected and weighed, and that the greatest care must be exercised by the sampler. When the sample is complete, the rubber cork is replaced in the tube, which should be cleaned with a dry, clean rag.

The dust sample should be as far as possible, representative of the air being breathed by the man at work, and it has been found by experiment that the best place to take a sample in a drive, a raise or a winze is about 10 ft. from the face. In a stope, the sample should be taken nearer the machine.

The object of dust sampling is to ascertain the amounts of dust present in the air being breathed by the men working in the mine, to trace that dust to its point of production, and, if the amount is excessive, to adopt measures to abate it. After taking the sample, notes on the following should be secured: Number of the tube; place where sample was taken; time of sampling; temperature; type of machine; nature of work in progress; character of holes being drilled; water appliances and how used; number of men and boys at face of the working; appearance of hanging; ap-

pearance of air (hazy, foggy or otherwise), and the sampler's impression of place and work, i. e. if care is being taken and water used. The sampler should make careful observations of the dust conditions of the mine and note the number of sprays and water blasts erected and in use; see that connections to water blasts and to water jets are installed and in order, and be prepared to give an opinion of the dust conditions of the mine and of the dust allaying appliances.



EMERGENCY AIR BAG

An emergency hood for protection from gas or other poisonous fumes is being marketed by the Safety First Supply Co., Hartje office building, Pittsburgh. This device, known as the Diamond emergency hood, is put on in six seconds, and one filling of air is sufficient for 15 minutes' wear. At the expiration of this time the wearer comes out into the open air, slips off the hood, scoops it full of air and cleanses it, after which he again fills it with air and is ready for another 15 minutes of service. The hoods are airtight and fireproof. Large, clear 6-ply mica windows, vulcanized in the hood, offer unimpaired front and side vision. The hood can be rolled so that it will slip into a coat pocket.

COMPRESSED AIR IN THE MANUFACTURE OF CONCRETE PIPE

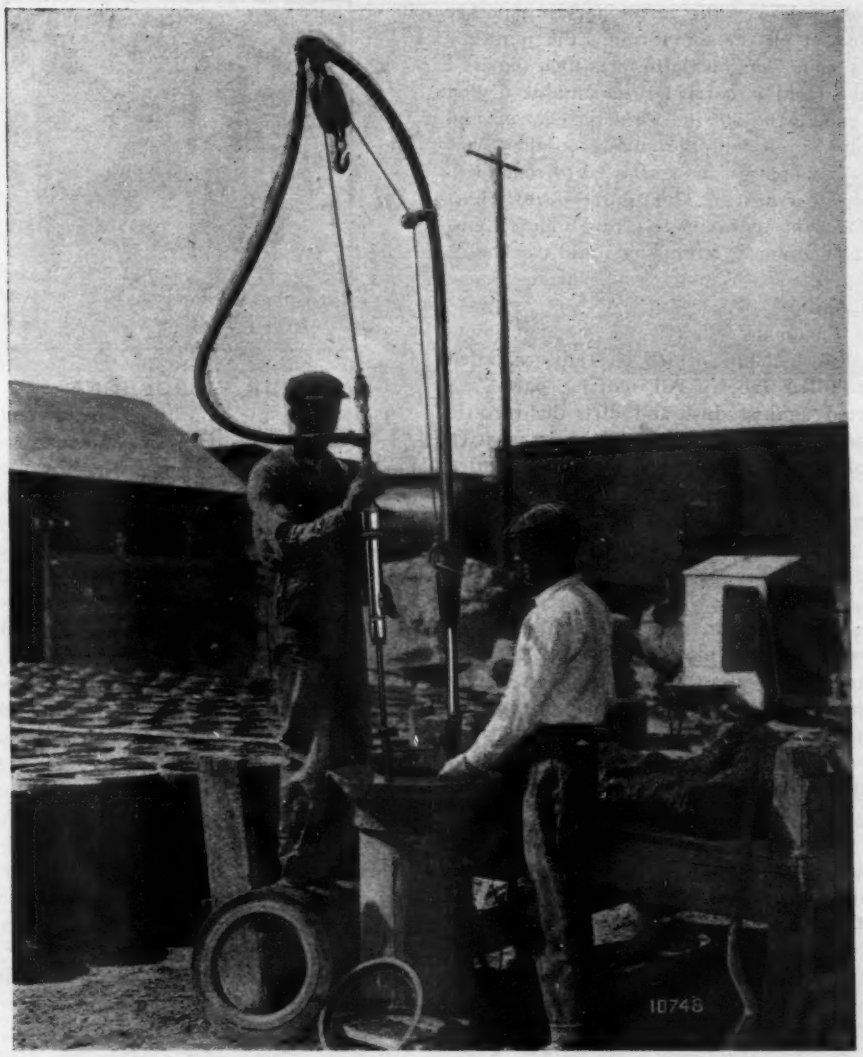
By D. W. C. Grove

The hand manufacture of concrete (cement) pipe has been the generally accepted method in vogue among pipe manufacturers for many years. This is in part explained perhaps by the fact that they have followed the lines of least resistance, seemingly secure in the belief that to manufacture a really "better" product was unnecessary because of the fact that their product as it was had a ready market.

With the demand which has arisen for pipe built to withstand higher pressures and to exhibit greater uniformity and density, the manufacture of concrete pipe has undergone a radical change, and, aided by pneumatic machinery, there is produced in many plants, not only the materially "better" grade of pipe demanded but a product which is of larger value commercially. In addition to these gratifying results of pneumatic pipe construction there is the important fact of increased production with the same force, with its resultant of reduced costs per unit produced.

Several concrete pipe manufacturers in California have installed air compressors and Crown pneumatic rammers, and the results have far exceeded expectations. Moreover, not only does the installation of an air compressor provide for pneumatic and mechanically perfect tamping of the concrete mixture but it offers a source of cheap power for the operation of various pneumatic tools, such as portable grinders, chipping hammers, etc., and further modernization of the process such as pneumatic conveyance of the mixture.

While there are some small points of difference in the details of manufacturing concrete pipe with compressed air, the essentials are very much the same and a description of one plant will suffice to give a thorough understanding of the subject in general. Upon advice of the manufacturer of pneumatic machinery who thoroughly investigated conditions before making a recommendation, a manufacturer of cement pipe installed a 7x6 in. air compressor, electrically driven, a compact self-contained unit. This furnished power for two Crown Pneumatic Rammers to provide for present needs, while a spare rammer was held in reserve.



RAMMING CONCRETE PIPE

These pneumatic rammers were counterweighted as shown in the illustration, rope and pulley blocks giving added flexibility of operation, so that the guiding of the tool around the form is the only physical requisite necessary to tamping. The tamping tool is formed from a straight steel rod, tapered at one end to fit the piston of the rammer. The opposite or ramming end of the tool is formed to a foot whose overall dimensions conform to the diameter of the pipe undergoing construction. The mold consists of two forms, for the inside and the outside of the pipe. The inner form is collapsible to permit ready removal, while the outer form expands for like purposes. These forms are set up on a sheet iron plate over a ring which centers both.

When the form is set up and ready for use it is filled with rather dry cement mixture and is tamped while being filled. The complete operation requires about 40 seconds on a ten inch pipe. When the form has been completely filled and tamped with the pneumatic rammer, the funnel is removed and the cement is packed at the top with a flat

ring slipped over the inside form. Another ring is set on the top forming the joint for the top end. The inside form is then removed and the mold is carried to a suitable drying place where the outside form is removed and the pipe is left to set, standing on the lower ring. The upper ring is allowed to remain to preserve curvature. This entire operation is performed in approximately two minutes, employing two men. If four men and two molds were used each rammer could make a pipe per minute.

The Pneumatic Rammer is a very simple and sturdy machine which is readily handled by unskilled labor. All moving parts are protected against dust and dirt, the throttle is handy to the operator and gives positive control of the tamping tool and the entire outfit is self contained.

Average time for completing length of concrete pipe:

12" x 1⅝" x 24".....41 seconds
14" x 1⅝" x 24".....46 seconds

It is interesting to note that in the manufacture of concrete pipe 12" x 1⅝" x 24", the operator, using a pneumatic rammer, encircles the form from 15 to 22 times during the molding of each length of pipe and delivers an average of 575 hammer blows every 45 seconds with the rammer. Comparing this speed with the speed of hand tamping, averaging about one blow per second, it is found that pneumatic tamping is over twelve times as fast as hand tamping. When it is considered that the operator of a pneumatic rammer can average his maximum speed during an entire working day without becoming tired and "slowing down," the evidence of increased production is plainly in sight.

The major advantages of pneumatic ramming in the manufacture of concrete pipe, as opposed to hand ramming under the older methods, can be summed up as follows:

1st—More pipe can be made in a specified time. 2nd—Pneumatic ramming results is a superior grade of pipe having greater density and uniformity. 3rd—There is no physical strain incidental to pneumatic ramming, and a cheaper grade of unskilled labor can be employed.

The world-old fact that the impossible cannot be accomplished by the use of hot air, however liberal the supply.—*N. Y. Herald.*

THE VIBROPHONE

This is an air vibrating whistle made by the Newman Manufacturing Company, Pittsburgh, Pa. It can be used wherever there is a supply of compressed air, making a loud, penetrating and distinctive sound always distinguishable from that of any ordinary steam or air whistle, even at a distance. It has no complicated parts to repair or keep in order, or to be lost, and can be easily screwed on to a ¾ in. pipe. The three parts of it are a brass cap, the megaphone and a phosphor-bronze diaphragm. The vibrophone is designed to operate with a pressure of from 25 pounds to 80 pounds of air. A good sound is produced with the minimum pressure, but the greatest penetrating and carrying power is obtained at from 60 to 80 pounds. It is claimed that the volume of air required is less than for whistles of the more familiar type.

COMPRESSED AIR IN A SHELL PLANT*

By R. E. C. Martin and S. B. King

The uses of compressed air are well demonstrated at the plant of Winslow Brothers Company, Chicago, which before the war manufactured ornamental iron and bronzes for architectural purposes. This business falling off, by reason of inactivity in the building line, the plant was converted to the manufacture of munitions, and a new equipment specially adapted to the manufacture of 155mm (6.1 in.) shells was installed.

The shell blanks are delivered to the factory in the form of pressed or drawn steel forgings, cylindrical in shape, with one end closed, weighing about 180 lb. each. In many of the

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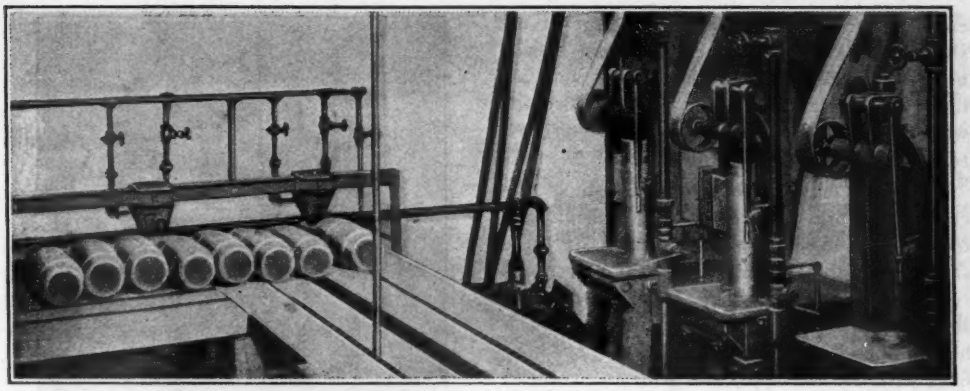
*From *Mine and Quarry.*



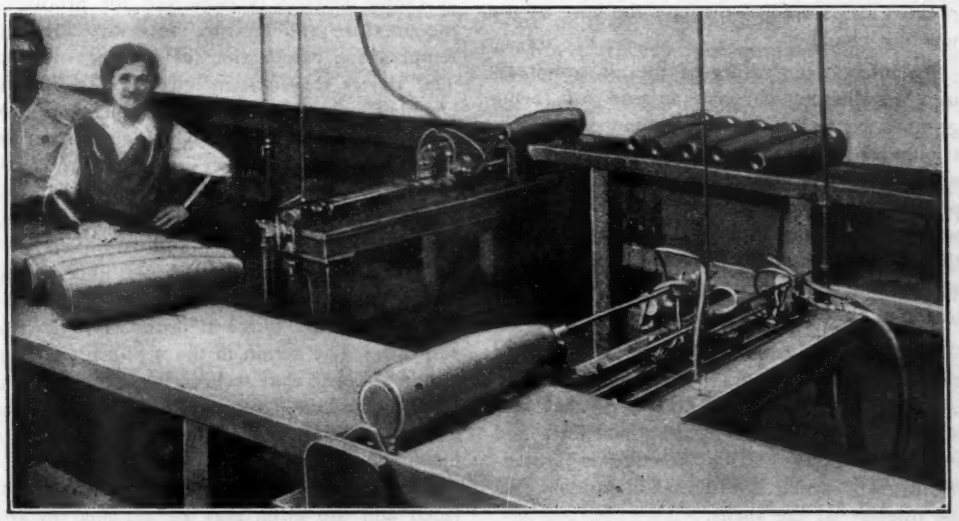
SAND BLASTING SHELLS

47 operations performed at this plant compressed air forms a time and labor saving agent of the first importance. Air chucks of improved standard pattern are used on practically all the lathes and boring tools for holding the work and releasing it quickly.

These processes include cutting off the end of the skull blank, rough and finish turning, turning the nose and base to exact dimensions, turning the bourrelet, turning the waved groove near the base on which the capper ring which engages the rifling is forced, turning the rifling grooves on the ring itself and boring out the interior of the shells. The use of air chucks, by means of which the work can be tightened or released instantly, has been one of the most important contributions to the cutting down of the time required in the turning process, and also saves considerable labor.

After the shells have been turned to exact dimensions, both inside and out, they are taken to the sand blasting machines, where the roughness left by the tool is carefully removed. Fig. 1 shows a battery of rotating sand blasting machines, with the shells in position. Two cuts or stages of sand blasting are performed. A preliminary blast is first given them, and they are then finished on the machines shown which put the final finish on the interior of the shell.

Compressed air is used also in the machine



VARNISHING SHELLS INSIDE

employed for washing out the interior of the shell. The shell is placed nose down over a nozzle through which steam, caustic soda solution or air can be discharged as desired to wash, dry and cool the interior. This process removes excess varnish, dirt, etc.

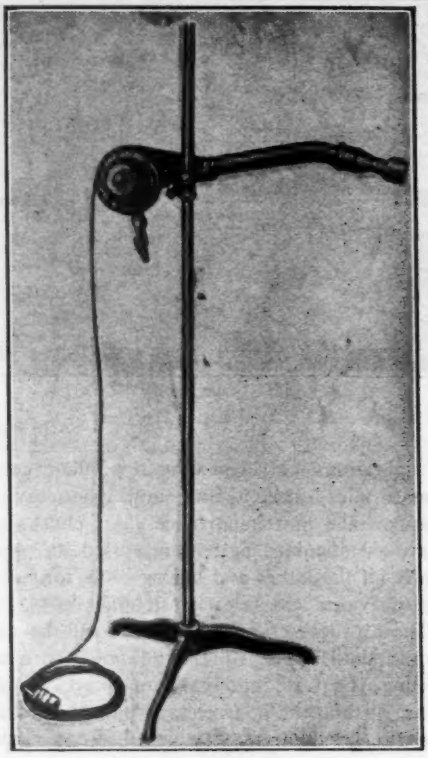
In Fig. 2 may be seen the varnishing machines at work. It would be a difficult and tedious job to varnish the interior of these shells, with the degree of care and evenness required, by hand. The type of machine shown consists of a sprayer mounted on a hollow spindle which is connected by hose lines with the air supply and with an overhead reservoir for varnish. It does the work rapidly and well. The spindle is moved forward into the shell and the varnish sprayed onto the interior surface as the spindle is withdrawn. The shell is revolved in the meantime, so that an even coating of varnish is applied.

This is one of the last processes through which the shell goes before it reaches the final inspection by the Government officials at the plant.

Compressed air is also used in the form of a jet to cool the primary windings of the shell-band-heating transformers, or ring heaters, which are employed for heating the copper bands, or rings, which are forced by powerful hydraulic presses into the machined groove near the base of the shell. On these bands the ridges for engaging the rifling are subsequently machined. The jet of compressed air is applied through the base of the winding chamber.

An interesting feature of the air compressing installation is that instead of being grouped centrally in a power house it is distributed about the plant at convenient points where the air is most used. As the four compressors employed are two-stage machines with efficient intercoolers the temperature of the air when it finally enters each high pressure cylinder is very little above that at which it enters the low pressure or intake cylinder.

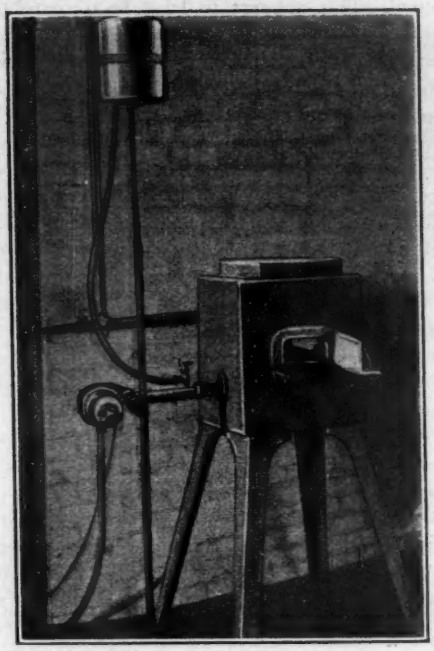
Receivers of ample capacity are installed close to the compressors. A 700 ft. aftercooler is also provided for the compressor that furnishes air to the sand blasting machines and varnishing sprays. It is effective in providing dry air, which is essential in sandblasting the interior of the shells.



A HIGH TEMPERATURE BLOW TORCH

This torch is made by the North American Manufacturing Company, Cleveland, and as here shown is adapted to a variety of uses. A simple method is employed for producing the pressure and mixture necessary for high temperature combustion of gas or oil fuel. The device consists in effect of a mixing chamber, motor-fan, delivery pipe, and nozzle. Flexible tubing supplies gas from the line, while a lamp socket connection and drop cord deliver current to the machine. A small electric motor-fan draws air into the mixing chamber where it meets and is mixed with the gas. This mixture then is impelled by the fan through a delivery tube to a specially designed nozzle, where it burns at high temperature. The action in the apparatus is similar in effect to that secured in a bunsen burner, with the added velocity and volume of the mixture contributing a higher temperature to the flame.

A floor stand with a vertical post is provided and the torch may be adjusted to any



FURNACE WITH BLOW TORCH

height. The flame developed by the ordinary burner is several feet in length. A supplementary burner, which may be readily attached, gives a flame about 10 inches long where a localized heating effect is desired.

The gas consumption for this torch is said to vary from 18 to 52 cubic feet per hour with artificial gas. A special burner is provided in case it is desirable to use oil for fuel.

The company recently has developed a larger burner on the same general plan as that described. In this unit a motor fan unit is installed so that its impelling blades deliver directly to a supply line running to the torch. At one side of the fan is a central intake from the gas supply line. Opposite to this is the air intake with a diaphragm opening which may be rotated to control the air supply. A special nozzle is used which has an air regulating valve. This latter is for use in event that the supply of air is delivered from one fan to several nozzles, and it is desired to cut down the supply to any one of them. The blower delivers the mixture of gas and air at about 4.7 ounces pressure, but will operate up to one pound pressure. The gas consumption for this unit, it is said, is 550 cubic feet per hour for natural and 800 cubic feet per hour for artificial gas.

Special burners also are manufactured by this company for use with fuel oil. These are in effect atomizers, supplied with air through the fan unit described previously. In this case air is secured at both sides of the fan and forced through to the nozzle. A small positive action rotary pump driven by a motor receiving power from a lamp socket is supplied to deliver the oil fuel under pressure. This pump is rated at 90 gallons per hour. Each of the oil burners described is designed to consume only 3½ gallons of oil per hour.

COMPRESSED GAS FOR MOTOR VEHICLES IN ENGLAND

The only instance in which compressed gas has been regularly used for some years is that of the Neath Corporation tramways, where the receivers are charged up to a pressure of 200 lb. per sq. in., the cost of compression working out to less than 5 per cent. of the total cost of the gas. At Neath, however, there are facilities for obtaining a fresh charge at reasonable and convenient intervals, so that conditions are scarcely to be compared with those in the metropolitan area. In fact, the London General Company find that conditions in general call for the employment of a very much greater degress of compression than has hitherto been found practicable, with the result that their new containers are to be charged to a maximum pressure of 1,000 lb. per sq. in.

The extremely high pressure involved has required the employment of storage cylinders of special construction. Two of these cylinders are used on each omnibus, being placed one on either side beneath the interior seats. The cylinders have each a compressed gas capacity of rather more than 600 cu. ft., so that a run of 20 miles may be made before recharging becomes necessary. The main body of the cylinders, composed of copper, is 10 in. in internal diameter and 9 ft. in length, while the two ends are formed of circular steel plates so fitted as to make a perfectly gas-tight joint on a radius formed on the ends of the copper tube. The whole is strengthened by six steel stays, which pass through the cylinder from end-plate to end-plate, and finally the exterior periphery of the cylinder is wound with three layers of steel tape in 1-16 in. thickness. It is pointed out that this

principle of construction will avoid bulging or sectional fracture, while any tendency towards distortion will be in the form of elongation, which is provided against by the longitudinal stays.

The two cylinders are connected in parallel, by a ⅜ in. pipe, to a main reducing valve which is a combination of a cut-out and diaphragm arrangement, and by means of this valve the gas pressure is reduced to some 2 lb. per sq. in. The gas then passes through a secondary valve into a flexible fabric container which operates as an expansion chamber, and practically as a governor. For instance, when the fabric chamber is fully extended it actuates a valve spindle which cuts off the supply, the surplus gas passing by way of a by-pass into the chamber of the reducing valve, which again cuts off the high pressure supply. Conversely, once the gas is emitted from the engine control valve the fabric chamber contracts and the series of operations is reversed so that a further supply is received from the containers. The system is particularly commendable in that it is entirely self-acting and demands practically no attention from the driver. The advances which have been made in the construction of valves for the purpose is shown by the fact that stuffing-boxes having proved unreliable have been replaced by seals formed by a combination of grease and rubber rings inserted beneath the valve body.

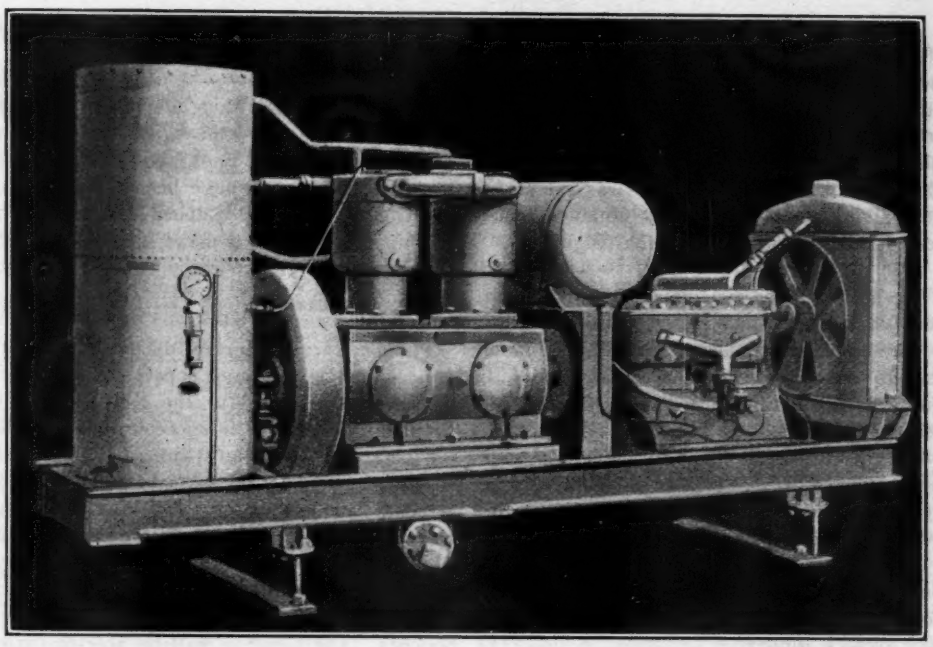
For recharging, the London General Company will have in operation at their Crickelwood depot a Reavell compressor having a capacity of 15,000 cu. ft. an hour. This compressor will be coupled to a series of storage cylinders of 30,000 cu. ft. capacity, controlled by a hydraulic accumulator, which is introduced for the purpose of ensuring the maintenance of a constant pressure. The whole installation is to be so arranged that a number of omnibuses may be recharged simultaneously from a common pipe line. In the earlier days of gas traction it will be remembered that the opinion prevailed that the engine designed primarily for petrol (gasoline) consumption was capable of yielding with gas only 85 per cent. of the maximum power obtainable with petrol; but it was then pointed out that were the engines designed for a higher compression the power ratio would compare very closely with that given for petrol. This appears to have been corroborated by experiments, for in a series of trials with the new arrangement it has been shown that the power obtained from the engine is equivalent to that obtained with petrol. The running figures which have been obtained are decidedly instructive in that they bear out previous estimates as regards the gas equivalent of petrol (in this instance the average relations being 280 cu. ft. of gas per gallon of spirit), while the average saving in cost, which is very considerable at low speeds, amounts to rather more than 50 per cent. as compared with petrol. The normal consumption of gas has been shown to be 35 cu. ft. per mile on a straight 10-mile journey.

As in the case of most gas vehicles the London General omnibuses are fitted with petrol supply arrangements for use in case of emergency. For this reason the ordinary petrol carburetor is retained. The change from one fuel to another is easily effected by engaging whichever throttle lever it is required to operate. A particularly novel feature of the new omnibuses is the use of gas instead of electricity for lighting. For this purpose a special reducing valve and governor are carried, the lighting supply being distributed at a pressure of 10-lb. per sq. in. Incandescent mantles are employed, and each is enclosed in a small fused silica protector. The merit of the system, however, lies in the fact that, whereas the usual electric generator installation weighs something approaching 3 cwt., the necessary apparatus for gas lighting runs to little more than 22 lb.

OUR GAS SERVICE

Some interesting facts in regard to our war activities are now beginning to appear. For instance, when the armistice was signed Germany was producing 30 tons of poison gas a day, England about the same, and France even less, while the U. S. A. during September and October were producing 200 T. a day and were just getting well started. One plant was to cover 200 acres, and in a small part of it 100 T. a day of chlorine was produced and 112 T. of caustic as a by-product.

And this work was as dangerous as trench warfare. During August the casualties in the mustard gas plant were 3.5 per cent. of the working force a day. Many were injured for life; not a few gave their lives in the service.



AN ENGLISH GASOLINE DRIVEN PORTABLE AIR COMPRESSOR

The machine here shown has been recently put on the market by Lacy-Hulbert & Company, Limited. It was designed to be employed in connection with temporary local work of various kinds, as bridge building, ship repairing, water raising, etc.

The arrangement comprises a gasoline engine with its fuel tank and radiator, an air compressor with its separate cooling water tank, and an air receiver. The component parts are all mounted on a stout frame built up of 6 in. and 3 in. rolled steel joists, so that the complete unit can be picked up and put down wherever it may be required. The weight is about two tons, and the overall dimensions 11 ft. 9 in. long by 3 ft. 2 in. wide by 5 ft. 11 in. high, so that it can conveniently be carried on an ordinary 3-ton truck and, if necessary, run at work without being unloaded.

The compressor is one of Messrs. Hulbert's two-cylinder, water-cooled machines. It works at a speed of some 320 revolutons per minute, and has a capacity of 130 cubic feet of free air per minute delivered at a working pressure of 100 lb. per square inch. The two cylinders are cooled by means of water jack- etc., which extend over the covers besides embracing the barrels. The valves are placed in the cylinder covers and are all removable independently. An unloading valve is fitted on the inlet branch. It is operated by the pressure in the receiver in such a manner that the load on the engine is relieved when the demand for compressed air falls off. The crank shaft of the compressor is fitted with a heavy fly-wheel at one end, and a toothed gear wheel at the other. The latter engages with a spur pinion keyed on an extension of the engine crank shaft, which is supported by an outboard bearing.

The engine generally employed is either of the Dorman, Aster, Parsons or Austin type, and is of some 32 brake horse-power when running at 1000 revolutions per minute. It is, of course, fitted with a governor. The radiator is of large capacity, and has a fan driven from the main crank shaft. The gasoline tank has a capacity of about 20 gallons, which is stated to be sufficient to keep the engine running for at least six hours. The air receiver has welded joints. It is fitted with a pressure gauge, safcty valve, &c., and has a 2 in. delivery connection. Above the receiver, but separated from it to prevent the transference of heat, there is a riveted steel water tank for cooling the air compressor cylinders on the thermo-syphon principle.—*The Engineer.*

AERONAUTICS

The United States Navy Department has successfully carried out the experiment of launching an airplane from a dirigible balloon. The airplane was attached by a 100-ft. cable to the dirigible; both rose to about 3,000 ft. and then the airplane was released; after diving about 1,000 ft. it obtained sufficient speed to continue its usual flight.

The approximate air-line distance between New York and London is 3,000 miles. Suppose an airplane capable of 200 miles per hour were to have a 100-mile following wind, it could make the distance in ten hours. As there is a difference of five hours in time between the two cities, the occupants would have to leave New York at three A. M. to arrive in time for a six o'clock dinner in London. But if they could find an east wind of 100 miles per hour they could leave London at one P. M. and arrive in New York at six, and have time to dress for New York's seven o'clock dinner.

In a note dealing with the possibilities of the commercial airships, issued recently by the British Air Ministry, it is predicted that future airships will have a capacity of 10,000,000 cu. ft.,a propelling apparatus of 6,000 hp., and a maximum speed of 85 miles per hour. These ships would be 1000 ft. in length, 150 ft. in overall height, possess a range of 20,000 miles, and could stay aloft for three weeks without requiring refilling. The crew would consist of three officers and 26 men, and the freight capacity would be 200 tons. The cost of a 10,000,000-cu. ft. airship is estimated at between $1,000,0000 and $1,500,000. From *Aviation*, February 1, 1919.

Further details are now available regarding the record flight of a U. S. Navy seaplane with 50 passengers at Rockaway on November 27. The machine was an N. C. 1 of the flying boat type, the wings having a span of 126 ft., fitted with three low-compression Liberty engines, each of 385 hp. The normal speed of the machine is 80 miles per hour, but with 50 passengers this was reduced to 72 miles per hour. According to the report of the Aero Club of America, the machine left the water within 1000 ft. at a speed of 45 knots, and rose to a height of 35 ft. It is stated that the machine can climb 2000 ft. in ten minutes.

Plans for a large dirigible of the Zeppelin type, 400 feet long, semi-rigid, with a lifting capacity of 25,000 pounds and a cruising radius of 2,000 miles, have been drawn up by the Goodyear Tire & Rubber Company. The airship is designed to make a speed of sixty miles an hour and to carry twenty-four people.

Plans to carry important documents to ships at sea, such as clearance papers and late mail, have been completed by the Kerr Steamship Company, it was announced to-day. Under the new plans, freight steamers will be able to save from thirty-six to forty-eight hours in clearing without waiting for bills of lading and agents' letters of instructions, said A. E. Clegg, vice-president of the company. These documents will be dispatched to the steamer and dropped on the deck in waterproofed pouches. The airplane will be able to maintain communication with the ship by wireless, and so find its position exactly.

The newest camera gun is mounted at the side of the regulation Lewis machine gun, and is operated by the mechanism of the Lewis gun. A new roll film of ninety-six exposures is part of the equipment. The camera gun has been invaluable for the training of aviators in aerial combat, and many bloodless duels have been fought over our aerodromes with it. A picture is registered with each shot, and the position in the picture of the other machine shows whether the "enemy" could have been brought down. A registering stopwatch is an important detail of the apparatus.

"I am looking for a cravat that will harmonize with a yellow monoplane, something not too loud in color, that will be effective at a height of sixty or a hundred feet."

Crude oil, just as it comes from the well, is a much better oil engine fuel than the residuums of the refinery, from which the lighter products have been removed. The crude contains the lighter "tops" which are easy to ignite and they, in turn, ignite the heavier constituents.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

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We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

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OUR NEW WINGS

Just as we write these words the aeronautical exhibition in New York comes to a close. There was in a way, little of surprise for us in the exhibits, as the daily newspapers and the technical press have kept us mostly informed as to the developments and achievements in the novel art of flying. Nevertheless, the show may be taken as the landmark of a great epoch of progress.

Entirely within the present century, and while it is still in its teens, the dominion of the air has been completely won. The greatest of all the inventions of man is a proved and complete success. Our wings though new are fully fledged. There is absolutely no uncertainty remaining as to the permanency and the reliability of the service the airplane is to render. It may easily be believed that it may do more to transform the ways of civilization than was accomplished by the railroads in the century preceding.

If this may be considered extravagant, we have only to remember how great a figure was cut in the World-War by the aviator, and by what his presence and activities entailed. All the formulated military strategy of the ages became a mass of absurdities at once, and the ways and means of war were thrown into chaos. And all this was accomplished while, at the beginning, the airplane was still in the experimental stage and the art of its successful manipulation had all to be learned.

The function of the airplane is in a way the same as, and an extension of, that of the railroad. It still more belittles time and distance and brings us all closer to each other. Within a time which we may as well begin to count by days a flight across the Atlantic must go on the record, and distance will no longer be a limit. We must expect to see and must provide for regular periodical flights along numerous routes between our greater cities and for independent flight in all directions. It is high time for moving to provide aerial landing fields conveniently located, and they must soon be looked for in city maps the same as railroad stations.

But another special adaptation of the airplane is for the reaching of out of the way and otherwise inaccessible locations. It can not only go anywhere with a speed undreamed of but it can carry considerable weights. This apparent disregard of mere weight as a seri-

ous handicap was perhaps the most striking feature displayed at the aero show. The airplane is to be the facile errand boy for the world, and when we remember how our mining camps are scattered through the wildernesses they perhaps above all others may welcome and profit by the air service. Many rich mines whose working has been impracticable may now become prolific.

HOW IT LOOKS OVER THERE

After the triumphant close (for Germany) of the war of 1870-71, the acquisition of Alsace-Lorraine and an enormous indemnity with which to give a jumping ground for her trade, Germany felt ready to claim that she was the top-dog of Europe. This legend was preserved, mostly by bluff and bluster, for, as we say, a period of 48 years. Perhaps there was rather more than the shadow of substantiality in her claim of predominance, for the future historian will confirm, what the present-day observer has already noted, that, at the outset, *she was very nearly winning* the stakes for which she played.

THE FIRST MENACE AND THE SECOND

This menace, which, in the first half of the period referred to, was aimed exclusively at the Military Powers of the Continent, was directed in the second half against the naval power of this country (Great Britain). Viscount Goschen was the first to utter the cry "Halt!" to the Tirpitz scheme, which was embodied by the Kaiser in his phrase "the future of Germany is upon the water." Subsequent First Lords of the Admiralty made similar attempts to come to an understanding on naval matters with Germany, but the answer to each effort was a new Navy Bill, engineered by the ruling powers and readily endorsed by the Reichstag, and the German people, who now want to cast the responsibility upon their Kaiser alone. Almost everyone felt and knew that this naval effort was directed against Great Britain.

How could markets, with the war cloud continually hanging over them, rise or fall on intrinsic merits, when they were buffeted by military and naval events? How could they dissociate themselves from the thought of an enemy, never so dangerous as when posing as a well-wisher, never so treacherous as when masquerading as a friend? How could tranquility be preserved with a recognized foe, whose thinly-veiled object was to destroy the naval supremacy of Great Britain and the military supremacy of all others? With an army restricted to (so it is said) 25,000 men, with a navy to which by the revised armistice conditions the seal of doom has been set, *and with the League of Nations ready to keep order and punish those who break it,* the world has a chance of rest and peace such as it has never before known, and so have the Markets. *Mining World and Engineer,* London.

NEW BOOKS

Model Making, including Workshop Practice, Design and Construction of Models, by Raymond Francis Yates, New York, the Norman W. Henley Publishing Company, 390 pages 8½ by 5½ in., more than 300 illustrations, $3.

This book, by the editor of Everyday Engineering Magazine, will interest and should be of value to a large and growing class of readers. It appeals to men rather than boys. It goes quite thoroughly into the operations of the shop both in metal and in wood, and then gives descriptions in detail of a great number and variety of models which have actually been made, including the most up-to-date lines of invention, all the war developments being included.

Compressed Air Plant, by Robert Peele, Third Edition largely rewritten, New York, John Wiley & Sons, 500 pages 6 by 9 in., 246 illustrations, 50 tables, $3.00.

Professor Peele's eminently practical, thorough and reliable book has deservedly and properly come to its third edition. The original matter has been more compacted and considerable new and up-to-date material has been added giving the work even a more standard character than before. The entire contents are readily usable and there is not the slightest suggestion of padding.

The all-metal airplane, is no longer the dream it was once supposed to be. It is little, if any, heavier than its wooden prototype, and much stronger.

The Hollinger, at Porcupine, Ontario, is the richest gold mine on this continent. In 1918 it produced $6,250,000 worth of gold and paid $1,230,000 in dividends.

MACHINE-GUN COOLING PROBLEM

The Inventions Section of the General Staff is desirous of obtaining a solution of the problem of improving the methods of cooling machine guns during continuous fire, and the prevention of the freezing of the cooling liquid during cold weather when the gun is not in use.

At present the ordinary water-cooling system is used. It is necessary to transport several boxes of water for each gun in the field, as the water in the cooling jacket quickly turns into steam during firing. The following points should be observed in the solution of this problem:

1. It should be easily obtainable
2. It should be easily carried
3. It must not be too expensive
4. It must not injure the metal parts of the gun
5. If possible, it should be capable of being used several times so as to avoid extra weight.
6. A minimum of waste during use should be obtained.

It must not be assumed from the above that a cooling system for machine guns must necessarily follow the lines of the present water-filled jacket. Any efficient method of cooling will receive serious consideration.

Correspondence in regard to this matter should be addressed to the Inventions Section, General Staff, Army War College.

GOVERNMENT NEEDS BOILER-MAKERS

Thirty first class boilermakers are urgently needed at the United States Navy Yard at Norfolk, Virginia. Pay ranges from $5.36 to $6.40 for eight hours. Permanent employment is assured. Thirty days leave with full pay is granted at the expiration of the first year of service and for each month thereafter, two and a half days leave are allowed with full pay. When overtime is necessary time and a half is allowed for all time in excess of eight hours. The Navy Department has authorized the Commission to furnish transportation to qualified men from point of departure to Norfolk, Virginia, if the men will agree to work for at least six months. U. S. citizens only will be considered. Full apprenticeship and good physical condition necessary. Application Form No. 1800 is required, which should be fully executed and filed with the Civil Service Commission at Washington, D. C. This form can be secured either from the Commission's office or from one of its field representatives. They are located in all of the larger cities of the United States.

THE JACKHAMER IN SOUTH AFRICAN MINES

In the course of his annual report, Mr. C. D. Leslie, the consulting engineer of the Consolidated Goldfields, pays the following notable tribute to the Jackhamer. He says: "As agriculture and industries advance it is to be expected that the supply of native labour for mining will be even less plentiful than it is at present. Approximately 41,000 natives, or double the number of natives employed on the mines of this group, are engaged in hand-drilling on the mines on the Rand, and as a means towards maintaining the rate of output on our gold mines it appears highly desirable to eliminate hand-drilling as far as practicable in favor of machines of the Jackhamer type. Extended trials with these machines at the Robinson Deep mine, as referred to in last year's report, gave very satisfactory results. It was found that each Jackhamer, employing an average of 125 natives, did the equivalent fathomage of seven hammer boys and used only 9 per cent. more explosive per fathom than was used in breaking rock by hand. In fathomage broken their duty showed an improvement of 12.4 per cent., as compared with that of reciprocating machines, which used approximately 86 per cent. more explosives per fathom broken. Considerable progress in the use of Jackhamers has been made at the Simmer and Jack mine, the result there corroborating those obtained at the Robinson Deep and justifying extending the use of the Jackhamer on each of our mines."

The Cement Gun Company, Inc., Allentown, Pa., organized by S. W. Traylor, president of the Traylor Engineering Company, will build a plant in France for the manufacture of the Traylor cement gun, to be used in reconstruction work in that country. A site is to be acquired along the Seine in the manufacturing section of Paris. The plant to be erected will cost about $500,000. Construction work will begin in February.

THE BIG ENGINEERS SHOULD BE BIGGER

The following is the substance of a principal part of an address, under another title, by Dean M. E. Cooley, University of Michigan, and President of the American Society of Mechanical Engineers, before the Detroit section of the A. S. M. E.

It is unnecessary to point out to a body of engineers what engineers have accomplished in the development of the material part of the world's civilization. The entire world, so far as its material structure is concerned, can very justly be said to be the work of the engineer, or of professional men very closely allied to the engineer and to engineering. Our great buildings, our railways, the subways of New York City, would not be possible without the work of the engineer. But it is not necessary to enumerate such features. It is enough to say that it would be difficult to think of anything that makes it possible to live the life we are living—I am speaking, of course, of the material side—that was not conceived by the engineer.

Then look at what has happened in our relations with different countries of the world through navigation on water and in the air, the latter developed to the most wonderful extent since the war began, and only in its infancy at the present moment. And look at the great conflict, with the result brought about by the work of the engineer—and the war itself brought about by the work of the engineer in the first place in helping to create commercial supremacy—fought and won by means designed and built by the engineer and I think if the engineer had the settling of the war, it would be pretty well done; but it is going to be settled by other than engineers, and it won't stay settled, you can be sure of that. I don't want to speak in any pessimistic way at all, and I don't think I am so speaking when I say that it is in my bones that the war has just begun, absolutely just begun—that is a thought for you to carry away with you. Some of you will recall your study of history and the days of Augustus Caesar, and following to the end of the decline of the Roman Empire, and at the beginning of the dark ages, when the Huns swept down and destroyed the civilization of the world. Who knows what the future has in store? Who can say that we are not going to have another dark age? I am not going to argue that we are at all—I just raise that question as something for you to think about. We are optimistic in this country. We are very optimistic with our opportunities in this country; we have no thought for the morrow except as we may make more than we made today.

I have tried to show you that the engineer stands preëminent in the world today because of his work, upon which depends so much, the civilization in which we live, and because of which we have seen also the destruction in this war of civilization.

Now, the engineer has done all these things in his professional capacity. We have wonderful experts. The different professions are filled with experts, men who know one thing and know it better than any other man in the world. It is natural that the engineer should become a specialist. It is the bread-and-butter thing for him to do. In doing this he is creating for himself a big reputation among his colleagues in engineering lines.

PUBLIC LIFE CALLS THE ENGINEER

But the engineering profession needs something more for itself, and the world needs something more from the engineer. The world needs the engineer with all his technical training to take a part in its general affairs, which up to now he has not taken. The engineer has not performed his duty to the general public. He has not given the general public the benefit of his knowledge which would enable many of the great questions which are puzzling the world today to be settled over night—if there was any desire to have them settled.

Take your Detroit street-railway situation—you may not have heard of that. It is as simple a problem as A, B, C; but does Detroit want it settled? What would be done for political capital if it were settled? I am told that the same thing is true of Chicago. The engineer's job, as I see it in such a situation, is to make it known that problems like these can be settled if the people want them settled, and that the engineers know how to settle them.

What is the best training for taking this position; going back to the college, for instance? I would say that the best training would be secured by first recasting the engineering curricula that we have. Leave out of them, at least, a quarter or half of the

professional stuff that is now taught, and substitute for it the good old stuff that we used to have crammed down our throats when some of the older of us were boys or young men. I believe it to be a fact that the engineer who was graduated back in the 70's or 80's was a much more broadly educated man than the engineer who is graduated today. He was a better man to cope with the general problems that arose in the field of engineering, for the man graduated today can do only one thing, as a rule, while in those old days he could do a good many things well. While this may sound like heresy, I believe, nevertheless, that we should make our education more liberal. And if I can do one thing more before I finish my work at the University of Michigan, and one thing while I am president of The American Society of Mechanical Engineers, it will be to hammer on the one thought that we must break down the walls which we are building around the young men who are in college—walls built so high that they cannot look over. Break them down and use your influence to have them broken down. See that your boys, who are going to become engineers, are so trained that they do not have to remain privates or non-commissioned officers in an army of engineers but that they can be field officers, line officers, major-generals, lieutenant-generals of engineering, men who are qualified to be on the hilltop and look far away and have a proper perspective.

Where do you find engineers occupying big public positions, political positions, if you like? But we do not like politics. How many engineers are there in Congress, how many in the Cabinet. How many on the public service commissions? Answer those questions and you will find where the unoccupied rung is. Perhaps we cannot do much in the little of life that is left to us, but certainly we can train those who follow us, and those who follow them. We should bring up in this country a different kind of engineer, a man who by his broad education and training will stand head and shoulders above the professional man of today. That is the kind of man I want to see, and you gentlemen can do it. My message to you tonight is to awake you to a sense of your responsibilities, not alone to your own profession but as an engineer and citizen to the public.

SAFETY PRECAUTIONS FOR HANDLING OXY-ACETYLENE APPARATUS*

By E. Wanamaker

Unabsorbed acetylene, that is, in a gaseous state as generated, is highly explosive at a pressure of two atmospheres or more due to the chemical instability of the gas itself. Acetylene is more or less unstable and liable to sudden explosive decomposition under certain circumstances. Accidents sometimes occur when it is apparently impossible to guess what precipitated the decomposition which resulted in the explosion. Acetylene gas at ordinary atmospheric pressure and temperature does not fly apart spontaneously and explosively into its constituents, but does so when exposed to considerable pressure while in a wholly gaseous condition as previously stated.

It has been ascertained that acetone has the property of being able to absorb about 25 times its volume of acetylene for each atmosphere of pressure at 60 deg. F. When acetylene is dissolved in this way it ceases to be spontaneously explosive and may be stored with acetone at pressures up to 250 lb. with comparative safety. Persons not fully acquainted with the properties of acetylene gas should under no conditions be permitted to undertake the compression of it.

Acetylene gas is comparatively non-poisonous when inhaled in highly diluted form in small quantities such as might escape from small leaks; the only poisonous effects that have been observed in connection with it were due to the presence of impurities in the gas, such as phosphoretted hydrogen. Therefore acetylene should always be secured as free as possible from phosphorous and other contaminating substances.

It has been found that one pound of carbide will generate 46 cu. ft. of acetylene gas, which if permitted to leak into a room six by five feet, will mix with the air in such a proportion as to make it an inflammable explosive that may be set off by a spark as well as by a hot iron or flame. For this reason it is always well when using an acetylene torch in a small enclosed space to see that a sufficient quantity of air is obtained to prevent acci-

*Abstract of a paper read before the Railway Fire Protection Association.

dents from such a cause. A little air blowing from an air hose will prevent any such accident as this even though considerable acetylene were leaking into the space.

Oxygen is manufactured directly as a chemical product or electrolytically from water. Oxygen itself as a gas is non-explosive. However, it is generally stored in metal containers at a very high pressure, generally about 1,800 lb. per sq. in. It is therefore apparent that an explosion may take place due to the failure of the container itself, permitting the gas to rush out at an enormous velocity.

It has been found at times when oxygen was made electrolytically, that, due to the crowding of the pressure or careless handling, a small percentage of hydrogen was permitted to mix with the product. Certain proportions of this mixture are highly explosive and may be set off by heat or jar. It is therefore necessary that oxygen be pure.

The following instructions for handling oxy-acetylene gas are strongly recommended:

In handling acetylene gas in tanks under pressure it should be remembered that at no time should the tank be allowed to remain near stoves, furnaces, steam radiators or any other sources of heat nor should they be exposed unnecessarily to the direct rays of the sun. Care should also be used in handling acetylene gas containers to avoid heavy jars. It must be remembered that any steel drum is liable to mechanical injuries if not reasonably handled. Acetylene cylinders should always be stored in an upright position with the valve end up.

Leaking containers should never be used and should one be found, it should be set out in the open air as soon as possible away from all possibility of ignition of the gas or of the mixture of gas and air that surrounds the container.

Open flame lights should never be taken into confined spaces where there is any possibility of acetylene. In case it is found necessary to use an acetylene tank in a small enclosed space a little air should be blown into the space from an air hose in order to secure a good circulation of the atmosphere.

All acetylene containers should have fusible plugs.

Neither oxygen nor acetylene containers should ever be allowed to remain where they are exposed to sparks or flame.

Oxygen containers should not be dropped nor handled roughly in any way and should not be placed where they may be overturned by a collision with other objects or by reaction caused by the violent escape of their contents through the safety outlet with which containers should be provided.

The regulating devices, valves and other attachments on oxygen containers should never be lubricated with oil or grease. Whenever lubrication is required it should be secured by the use of pure graphite unmixed with either oil or grease. Furthermore the discharge valves of oxygen tanks should always be opened slowly and care should be taken to avoid twisting or straining them by the use of hammers or improper wrenches.

The hose and hose connections used between the gas manifolds or gas tanks and the welding torch must always be maintained free from leaks and all joints made mechanically tight and secure. The regulating valves and torches must be kept in good state of mechanical repair to avoid leakage of the gases. No part of the equipment to which hose is attached should be used without securing the hose with the proper size hose clamp. Wire fastenings should not be used in any case.

In case of any trouble with the torch the gas should be immediately shut off at the tanks or pipe line station.

Where generating stations are used the instruction cards sent with the parts must be carefully followed and no leaks must be permitted on any of the pipe lines.

No man should be permitted to use the gas welding torch until properly instructed by a welding supervisor or some experienced welder, and if he is not the regular operator permission of the foreman in charge should be obtained before the machines are used.

Safety gages should be used on all regulators, that is, gages having loose or vented backs, so that in case the pressure on the gage builds up to a dangerous degree or builds up too rapidly, such as might cause a rupture of the Bourdon tube the force will spend itself without breaking the glass case, thereby causing possible injury to the operator.

Some shops use portable welding outfits, purchasing tanked gas and tanked oxygen. Other shops install acetylene generating outfits, also oxygen generating outfits, piping the gas throughout the shops having manifold

outlets to which the hose from the welding torches are connected. Still other shops generate acetylene gas and purchase tanked oxygen, connecting it to a manifold which in turn is connected with a system of piping in much the same manner as the oxygen generating plant. Each generating plant that is installed is equipped with a complete set of instructions for intelligently operating the generator, the most important of which are: "Remember to keep all light or fire of any kind away from the plant and never permit the generator to remain more than five minutes unless the generating chamber is filled with water, even when it is not in use." If the instructions that we have given in this paper and the detailed instructions which are given out with the generators are carefully followed out and leaks of all kinds prevented in the distribution piping system of the installed plants, there will be practically no danger from fire.

A MINE RESCUE RECORD*

On the morning of January 20 the fire bosses at Mt. Braddock mine discovered smoke in the return air current, and the men were not permitted to enter, except six who went in to start the pumps and locate the fire. The mine is a slope and the active workings are about a mile and three-quarters from the opening. The main haulage slope is paralleled by the manway, both of which being return airways. The fire was on the intakeairway and all the gases generated were being carried through the mine.

Three men from the Orient Rescue Station arrived early in the afternoon with breathing apparatus and entered the mine by way of the main slope, traveling down about 4,000 ft. through the smoke to the main parting, where they found two men, one unconscious, who had found a leak in a compressed air pipe and remained at that point. Both men were unconscious when they reached the surface and were taken in hand by John C. Struble, inspector for the H. C. Frick Coke Company, who had just arrived with his rescue team, and by means of artificial respiration and oxygen were revived. Mr. Struble decided to change the ventilation and prevent the fire gases from getting to the section where the other four men were supposed to be. His rescue crew, with breathing apparatus, constructed a temporary brattice.

The Bureau of Mines at Pittsburgh got away five men in twenty minutes after receiving word, but they were stopped on the way by mud roads and were picked up by Stephen Arkwright of the H. C. Frick Coke Co. and S. J. Ryan of the Mine Safety Appliance Co. and all arrived about the time the brattice was completed.

An exploring party of ten men equipped with breathing apparatus, safety and electric lamps and a canary, entered the mine following the run intake. In following the fresh air they traveled a circuitous route, carefully chalking their way, and after two and a half hours reached the main haulage slope. Before passing the door separating the intake and return two men went ahead examining the return air with safety lamps and the canary. The air being clear the party went through the door to the slope, located a telephone and made a report to the outside. Following a rest, the rescue crew proceeded down the left slope where two men were supposed to be at a pump, and after traveling about 600 feet they saw a light approximately 400 feet ahead, apparently in the hands of someone staggering, which they approached cautiously and found Charley Terch, who fell to the ground when they reached him. He was given oxygen from one of the breathing apparatuses and quickly revived and was able to tell that his "buddy" was back along the slope somewhere unconscious.

The other members of the party then proceeded down the slope and found Elmer Matthews about 3,000 feet from the parting, or about 2,000 feet beyond the first man recovered. They revived him after a time with artificial respiration and oxygen, but he was unable to walk and was carried back to the parting, where he responded to first aid treatment. These men were unable to give any information as to the location of the other two men, so after a conference it was decided that they were evidently in the vicinity of the other two pumps, which were located at the bottom of the right hand slope. Arkwright, Parker and Ryan, with five men and apparatus proceeded down the right slope to explore for the other two men, leaving the other members of the rescue party to look

*Condensed from *The Coal Industry.*

after the two recovered men. The latter party communicated with the surface and had a trip sent down with blankets, stretchers, hot coffee and other stimulants.

Arkwright's party located the two pumps, but found no trace of the men other than a safety lamp. After exploring all the working places, they started out the manway and found James Russell, who was partially conscious and quickly responded after oxygen was given him. He had no idea of where he was or how long he had been there and could give no information about his companion. Two of the party remained with him and the others continued up the manway and found Frank Largon about 300 feet beyond. He was in bad condition and did not respond to treatment for approximately a half hour, and while three of the party worked on him, the others returned to the main parting for stretchers and assistance, upon the arrival of which two men were carried out to the parting and were given stimulants and plenty of oxygen. Largon had made up his mind that he was going to die and he apparently did not want to change his mind and refused to breathe the oxygen, and at one time the whole party was working on him, rubbing him, holding safety lamps around him to keep him warm and trying to get him to take stimulants and oxygen. He finally wanted to fight Struble and the anticipation of this pleasure was sufficient inducement for him to decide to get well.

Now came the problem of getting these four men to the surface, 4,000 feet, by way of the slope, the most direct route. It was plainly evident that it would be impossible to carry them back. They were also confronted by the fact that, while the air was good on the slope at this point, about half way up the slope the return from the fire section joined the return on the haulage slope. To determine the condition of the air it was decided to send a canary and some safety lamps on the trip. As soon as the trip reached the surface they examined the canary and found it had been overcome, and the safety lamps had been extinguished. This information was communicated to the party underground and after a conference it was decided to have additional rescue apparatus sent down for the four recovered men and those whose oxygen was partially exhausted; also to send a fresh canary and additional safety lamps to again check the condition of the air. Fortunately there was plenty of apparatus on hand as additional apparatus had arrived. The above program was quickly carried out and when the trip arrived at the parting the canary was overcome but the safety lamps were burning. The four rescued men were placed comfortably in separate cars and apparatus placed on them and two of the rescue crew were assigned to each car in which the men were placed. All of the apparatus was tested out carefully, and after 11 of the party were placed, McCaa and Zorn examined each apparatus and turned on the oxygen, then examined each other's apparatus and got aboard. Struble at the telephone gave instructions to hoist in two minutes, which seemed like an hour. The trip started and in 10 minutes the 14 men, all wearing breathing apparatus, reached the surface in fine shape, 8.10 A. M., January 21. The four rescued men had been underground just 24 hours and the rescue party 7 hours, having entered the mine about 1 A. M.

LOCATING SUBMERGED SUBMARINES

Many devices have been thought out and perfected during the present war for locating enemy submarines when submerged. According to an article in *L'Illustration* for February 8th, the French claim that the more recent successes were due to an invention of one of their officers, Captain Walser. This inventor's idea is based on the refraction of sound-waves when transmitted from one medium to another. When coming from a source situated some distance away these waves are parallel, and remain so on condition that their propagation is unimpeded. In practice, the device consists of an "acoustic" lens, which causes the waves to converge to a centre—which in this case is inside the observation boat—when they are strengthened and capable of isolation. The different points of emanation set up as many distinct foci as there are points, the geometric loci of these foci being approximately a circle. As the seat of the foci depends on the direction in which the sound is travelling, the position of all may be deduced from a knowledge of the position of one of them. The lens is formed by a number of discs, capable of vibration, which cover a number of holes drilled in plates

placed on each side of the vessel, these plates replacing the hull itself at these particular parts. The sound is transmitted to sound-horns capable of suitable motion by special gear. When the observer is listening, the horns—one on each side—are trained by him until they arrive at the position corresponding to maximum intensity. Either empirical or comparison methods are used in judging the distance away of the submarine whose bearing is sought. The apparatus described closely resembles the hydrophone originally developed for use with submarine bells, and during the war employed for the detection of submarine boats, &c.

NOTES

The headings of the Otira tunnel, New Zealand, were joined in August. The tunnel is five miles twenty-five chains in length, and has been under construction since May, 1908. Owing to scarcity of labour and material it cannot be completed for another two years.

The Automobile Chamber of Commerce announces that at a joint meeting of committees representing tire and aumobile manufacturers, it was decided that all restrictions that had been adopted as a war measure on the manufacture of certain sizes and styles of pneumatic tires for renewal purposes would be removed and that tires of all sizes would be made as long as there is a demand for them by the public.

Fearing that returned soldiers will attempt to make use of the army gas masks in coal mines or other places where poison gas may have accumulated, Director Manning of the Bureau of Mines makes the following statement: "The army gas mask should never be used in mines, because of the uncertainty that exists as to the amounts of gases in the atmosphere and the liability of there being insufficient oxygen to support life. Its use in the mines will lead to serious accidents and fatalities."

Carbon dioxide has been successfully used in Australia for exterminating the weevil which has been destroying stored wheat in vast quantities. The infected wheat is stored in air tight stackhouses into which carbon dioxide is pumped until the live weevils are destroyed. The eggs and grubs which remain are killed by heating the wheat in special machines to 140 deg. F. for three minutes. It is claimed that the character of the wheat is unaffected and that there is no tendency for weevils to develop again unless exposed to a fresh source of infection.

A novel ship repair job has been recently carried out in Buenos Aires. The ship was a wooden vessel called the Paloma Argentina, of some 200 tons displacement. The wooden ribs of the vessel were quite rotted away at the bottom, and the repair consisted in casting in armored concrete ribs between the existing wooden ribs, the ribs being bonded to the skin by coach screws driven partly into the latter. Here and there extra deep concrete ribs with special reinforcement were taken over the inner or false keel. The repair is reported to be quite successful, and as the concrete takes the place of ballast, has added nothing to the weight of the vessel.

The last annual report of the Bureau of Fisheries states that the Bureau coöperated with the public Health Service in the task of protecting soldiers from malaria in one of the large southern cantonments. All available means were used to protect and increase the supply of top minnows (*Gambusia*) in the adjacent waters and careful observations were made on the effectiveness of these and other fishes in the extermination of mosquito larvae. It has been fully demonstrated, says the report, that small fishes are in many cases most effective agents for the control of mosquitoes, but their effectiveness depends upon various conditions, such as the presence of debris and of plants of various species, wave action, fluctuations of level, etc., and definite knowledge is lacking concerning the part played by these factors.

The City of Milwaukee has been greatly bothered with a peculiar taste in its drinking water. This water is obtained from the lake and is chlorinated before distribution. At first it was thought that the chlorine produced the taste, but a series of tests proved that this was not the source of the contamination. There seemed to be some connection between the intensity of the taste and the direction of the wind, and finally the source of

trouble was located in a couple of plants, one three miles away and the other eight miles away, which were producing coal tar products. Quantities of phenol were allowed to escape in the waste, and upon test it was shown that this would produce a noticeable waste, even when diluted to one part of phenol in 500 million parts of water.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JANUARY 7.

1,290,155. AIR-CHAMBER FOR PUMPS. Norman O. Fleming, Huntington Park, Cal.

1,290,241. ART OF PURIFYING FIRE-CLAYS. Henry L. Kohler, St. Louis, Mo.

1,290,291. PRESSURE-RELIEF APPARATUS. Herbert B. Morrill, Salem, Mass.

1,290,334. OIL-BURNER. Harry A. Paxson, Altoona, Pa.

1,290,389. POWER REVERSE-GEAR. Jacob Rush Snyder, Pittsburgh, Pa.

1,290,459. MACHINE FOR MIXING AND PLACING CONCRETE AND OTHER MATERIAL. Wylie Gemmel Wilson, Elizabeth, N. J.

1,290,461. PNEUMATIC ACTION FOR AUTOMATIC PLAYING MECHANICS. Luman Birch Wing, Brooklyn, N. Y.

1,290,607. AIR-REGISTER FOR OIL-BURNERS. Luther D. Lovekin, Philadelphia, Pa.

1,290,643. PNEUMATIC DOOR-CHECK. Hjalmer A. Nelson, St. Paul, Minn.

1,290,662. PRESSURE - PRODUCING APPARATUS. George D. Pogue, St. Louis, Mo.

1,290,703. AIR-LINE EXHAUSTER FOR STEAM-HEATING SYSTEMS. Joseph H. Brady, Kansas City, Mo.

1,290,756. HOT-AIR ENGINE. Alexander T. Kasley, Swissvale, Pa.

1,290,758. PNEUMATIC TUBE OR CHUTE. Henry P. Kraft, Ridgewood, N. J.

JANUARY 14.

A wave force utilizing device comprising an inclosure having an inclined wall dividing said inclosure into a wave receiving and a water confining chamber, a plurality of valves on said wall arranged to be opened by incoming waves and confine water in said chamber, an outlet on said confining chamber, a compressible bag in said chamber, an air supply pipe for said bag, and a valve controlled air outlet for said bag.

1,290,875. AIR-SPEED INDICATOR FOR AEROPLANES. Abram T. Baldwin and Sigwurd L. Christenson, Detroit, Mich.

In an air speed indicator, a movable element adapted to be subjected on opposite sides to different pressures, means to laterally adjust the position of said element and an indicating element movable in a plane at right angles to the plane of movement of said movable element and connected with it.

1,290,994. COMPRESSOR FOR REFRIGERATING SYSTEMS. Clarence M. Holley, Detroit, Mich.

1,291,016. FLUID-CUSHION DEVICE FOR AUTOMOBILES. Charles Snow Kellogg, New York, N. Y.

1,291,099. AIR-EXHAUST AND VACUUM SEAL VALVE. Lewis F. Ostrander, St. Louis, Mo.

1,291,130. EDUCTION-PIPE FOR AIR-LIFT PUMPS. Arthur William Purchas, York, England.

An eduction pipe for air lifts, the cross section of which varies in steps, the maximum cross section being at the bottom and adapted to be submerged, the minimum cross section following the maximum cross section, the section larger than the minimum but smaller than the maximum following the minimum section.

1,291,456. PNEUMATIC APPARATUS FOR TAKING OFF SINGLE SHEETS FROM PILES. Shimon Feldman, Petrograd, Russia.

1,291,488. METHOD OF PNEUMATIC CONTROL OF VARIOUS MECHANISMS. Walter G. Haas, Dayton, Ohio.

1,291,504. AIR-PUMP. George Edgar Hazard, Rochester, N. Y.

1,291,520. ROTARY COMPRESSOR. Conrad Hoerl, Newark, N. J.

1,291,589. PROCESS FOR THE COMBUSTION OF GAS. Harry R. Maxon, Muncie, Ind.

A process for the combustion of gas which consists in supplying gas and air to a mixer, regulating the gas and air to the relative proportions required for complete combustion, mixing the gas and air, conducting the resultant mixture to a burner, burning the mixture, and maintaining the speed of flow of the mixture at the lowest rate necessary to prevent back firing.

1,291,609. AIR-COMPRESSOR VALVE. Samuel Z. Nichols, Milwaukee, Wis.

1,291,670. PNEUMATIC ACTION FOR AUTOMATIC MUSICAL INSTRUMENTS. Hervey Evelyn Gamble, London, England.

JANUARY 21.

1,291,802. SUCTION-CLEANER. Ora Drake, Cleveland, Ohio.

1,291,854. UNLOADER FOR COMPRESSORS. Harry V. Haight, Sherbrooke, Quebec, Canada.

1,291,862. FLUID - PRESSURE - ACTUATED VALVE. Mark L. Harned, Washington, D. C.

1,291,875. COMPRESSOR - CONTROLLING MEANS. Herbert T. Herr, Pittsburgh, Pa.

1,291,983. COMPRESSOR. Gustave F. Maisch, Chicago, Ill.

A gas-compressor in combination with a lubricant reservoir, and means actuated by the gas operated upon by the compressor to feed the lubricant from said reservoir to its place of use, substantially as described.

1,292,038. TURBINE-ENGINE. Peter Phillip, Chicago, Ill.

1,292,077. ELECTRIC CONTROL OF FLUID-PRESSURE-ACTUATED MOTORS. Harold Rowntree, Kenilworth, Ill.

1,292,318. AIR-BRUSH. Birchard E. Holton, Los Angeles, Cal.

1,292,362. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. Joseph A. Obst, Pawtucket, R. I.

JANUARY 28.

1,292,430. CAR-DOOR-OPERATING MECHANISM. William M. Cady, Edgewood Park, Pa.

1,292,549. FUEL-FEEDING SYSTEM. Frank E. Wellman, Kansas City, Kans.

1,292,562. ART OF COOLING AND DRYING AIR. William J. Baldwin, Brooklyn, N. Y.

1,292,665. AIR-GUN. Ude P. Udesen, St. Paul, Minn.

1,292,731. COMPRESSED-AIR POWER PLANT. Henry P. J. Earnshaw, Boston, Mass.

1,292,851. LIQUID-ELEVATING APPARATUS. Thomas W. Murphy, Philadelphia, Pa.

1,292,898. APPARATUS FOR SPRAYING AND ATOMIZING LIQUIDS. Eli Slater, Kinders, Greenfield, England.

1,292,905. AIR-PUMP. Samuel A. Snell, Mineral Ridge, Ohio.

1,292,940. GLASS-BLOWING MACHINE. Arthur Wilzin, St. Ouen, France.

1,292,963. VACUUM-CLEANER. Daniel B. Replogle, Berkeley, Cal.